The Journal of The Engineering Institute of Canada

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To The Engineering Institute of Canada.

Gentlemen:-

The Institute is to be congratulated upon both the growth which has made the Journal possible and the actual development of the publication.

The quality of the whole fabric of closely interwoven interests which it serves will be improved by the Journal. It is an organ needed by both the Dominion and the Institute. It will bind the branches together and facilitate the gain and interchange of professional knowledge.

The development of Canada's vast material resources, from the conception to consumption - the production, transportation and marketing, must be brought about by engineers in all fields. A medium which stimulates their work aids in the increase of Canadian production.

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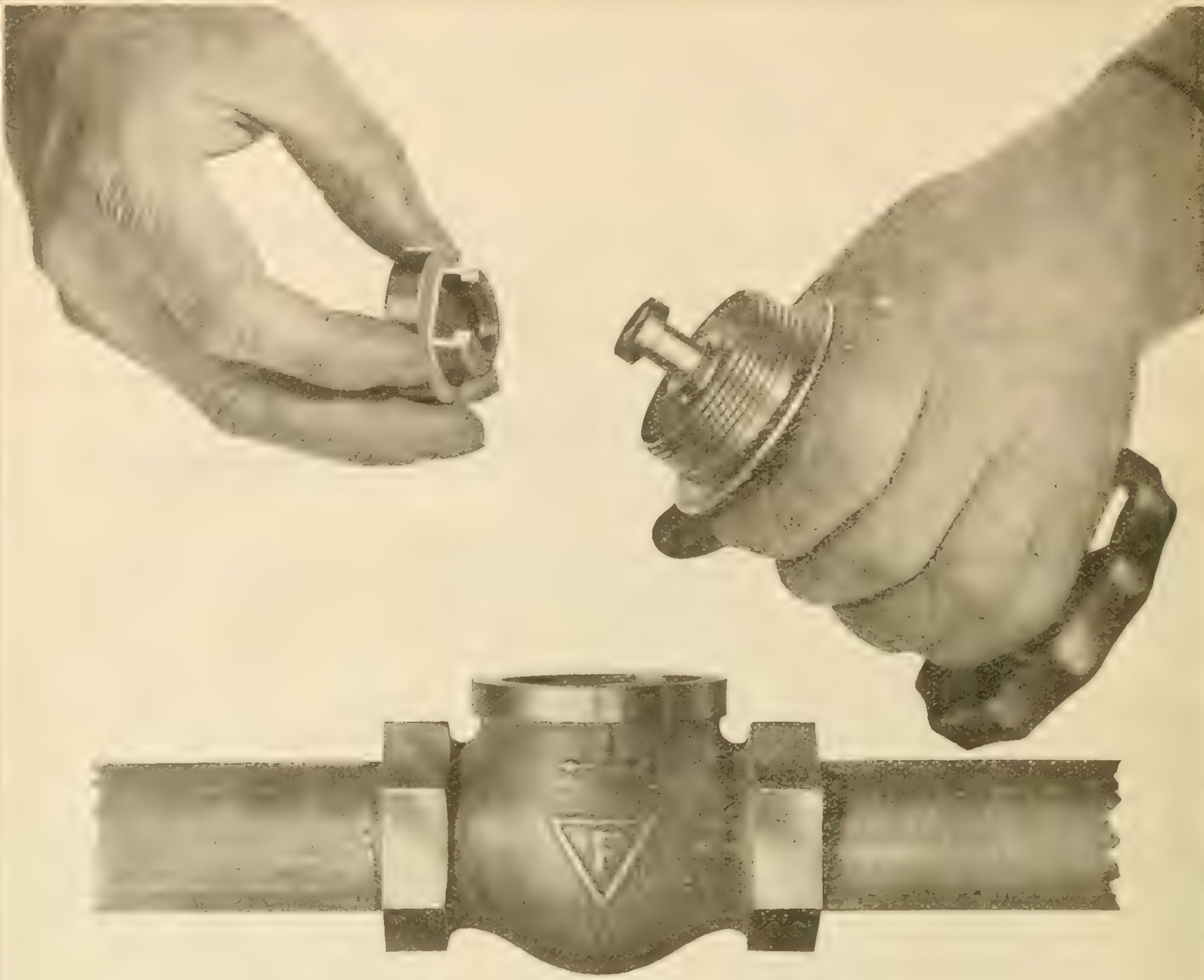

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H. H. VAUGHAN, M.E.I.C.
First President of The Engineering Institute of Canada.

THE PRESIDENT'S MESSAGE

THAT the first issue of our monthly Journal should report the first general professional meeting of the Society can hardly be regarded as a coincidence but we may certainly hope that it may prove an omen of increasing success and a broadening field of usefulness for the new Engineering Institute of Canada. The change in name, with all that it involves, the holding of professional meetings in various provinces and the publication of a journal are the concrete results of the recommendations made by the Committee on Society Affairs which have led to such important alterations being incorporated in our new by-laws. The change in name implies the attempt to unite all engineers in Canada, to whatever branch of the profession they may belong, into one Society. The provincial and branch organization and the general professional meetings will enable our members, in whatever province they reside, to meet together for the interchange of knowledge and become acquainted with each other and their problems. The Journal will afford us all a means of being better informed on the activities of the Society throughout the entire country, for keeping our members more closely in touch with each other and with headquarters and for increasing the usefulness of the Society to its membership.

Our new development may be ambitious but it contains great possibilities. In spite of the terrible times through which we are passing the results, so far, are most encouraging. Our membership applications are not only increasing in numbers but include many eminent engineers who had not previously joined our Society.

Our first professional meeting was most successful, thanks to the ability and hard work of the officers of the Toronto and Ottawa branches. This Journal is the commencement of another effort to carry out our programme and let us all wish it success and endeavour to promote its success by every means in our power.

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FIRST GENERAL PROFESSIONAL MEETING

Fuel-Power Problem of Canada Given Two Days' Deliberation. Conclusions Reached. Committee of Council to Bring in Final Report.

A discussion of the present fuel and power situation in Toronto on March 26th and 27th, marked a new era in the affairs of the Engineers in Canada by meeting to discuss a question of general public interest.

THE first general professional meeting in Toronto brought out several noteworthy points in connection with the relation of members of the engineering body to the outside world and to each other. It is of more than passing interest that besides being the first general professional meeting, it represented for the first time joint action by two branches, co-operating with headquarters and in a way that reflects credit upon the officers of the branches in holding a meeting of unusual interest to the whole Institute.

The programme drawn up by co-operation of the branches with the papers committee of the Institute and sanctioned by Council, while having one definite object,—a discussion of the present fuel and power situation,—was the most comprehensive ever attempted and was, as is generally admitted, the most successful. From the time of assembling at the Engineers' Club, on the morning of Tuesday, March 26th, at nine thirty A.M., until the closing smoker, on Wednesday evening, the entire course of the proceedings was marked by a spirit of serious deliberation, underlying a note of good fellowship that dominated the conference.

While both the Ottawa and the Toronto Executives are to be congratulated on the result of this meeting, the Toronto Branch officers are entitled to the warmest praise for the splendid manner in which the detailed arrangements for the meetings were planned and carried out.

Summary of Deliberations

A committee, consisting of the Chairman and Secretary-Treasurer of the Toronto Branch, the Chairman and Secretary-Treasurer of the Ottawa Branch and the President and Secretary of the Society were appointed at the final session to draw up the conclusions of the meeting. This summary was prepared with the assistance of the authors of the papers and was read by Mr. George Hogarth at the smoker on Wednesday evening, as follows:

Believing that a discussion of the all important fuel-power problem by its members would result in the development of ideas beneficial to the whole Dominion, the Canadian Society of Civil Engineers planned a two days' conference which has just closed in Toronto, where a number of valuable papers were delivered by experts on the subject, leading to a discussion of the various phases involved, with suggestions as to a policy to be adopted.

H. H. Vaughan, president of the Canadian Society of Civil Engineers, who presided at the meetings, called attention to the fact that the papers to be presented were of two characters. One of these dealt with the immediate relief of the present situation and the other evolving a policy of a future rational use of fuels and the development of power.

It was pointed out at these meetings that the fuel and water-power resources of Canada were of enormous extent, and in view of this it was incumbent upon the Canadian people to develop these resources in a scientific manner and make them available for use as soon as possible. In the meantime, as far as Canada is concerned, and particularly the middle portion of the country, we were still dependent upon the good will of the United States for fuel supplies.

Of those fuels which offer relief from the present situation wood stands out as the one source of supply from which immediate help may be expected, and consequently, as far as Ontario is concerned, it is imperative that aggressive action be taken by the various municipalities to provide a supply of wood for domestic purposes for the coming winter.

It was shown that the art of manufacturing, and using peat fuel has been well advanced in other countries so that there is little doubt that air dried machine peat will in the near future be used to some extent to take the place of coal. Peat is particularly well suited for gas producers more especially those of the by-product type. When burned under boilers the steam raising value of peat is about one-half that of good coal.

THE BEST USE OF COAL

A further relief in the fuel situation is promised by the industrial evolution of the carbonization of cooking coals which led to the employment of high temperatures which give strong metallurgical coke and high yields of city gas. A commendable reaction has set in towards low temperature and high tar yields, as tar oils are increasingly needed for motor fuels. A systematic investigation of lignites now in process in the fuel testing laboratories at Ottawa shows that a valuable fuel of high heating value can be made by suitably controlled carbonization followed by briquetting. Carbonized peat or peat coke is a high grade fuel which need not be briquetted.

A rational development of Canada's fuel resources would indicate that, on account of its importance and exhaustible nature, coal should be won and used for the purpose for which best suited. Suggestions as to this development were: 1. Substitution of coke for anthracite; 2. The introduction of by-product coke ovens, and the transformation of gas plants to include more thorough by-product recovery. 3. Carbonization and briquetting of low grade fuels. 4. The use of pulverized coal as a locomotive fuel. 5. The elimination of waste in mining. 6. Greater use of western coals to replace imported coal in the area west of Port Arthur which includes avoiding the use of fuel requiring a long haul wherever it is possible to procure a suitable substitute requiring only a short haul. 7. By the earliest exploitation of our own resources to aim at limiting the necessity for importing fuel from other countries.

While oil fuel is an ideal fuel for all purposes it will never be a competitor of coal to any extent in this country unless the production of oil is materially increased, but it will always be a splendid supplementary fuel to coal.

FUEL CONSERVATION

The possibilities of the relief of fuel consumption in Canadian industries by the increased use of hydro-electric energy lie, first in the limitation in existing plants of the use of coal to heating purposes only wherevet hydro-electric power is available, such limitation having as its objecr the restriction of the use of unreplacable material by power derived from natural sources which do not suffer depletion by use. Second, the establishment of a national policy which will ensure factories in the future locating at points where their demands for raw material and power may be met by the most economical use of such materials and facilities as are indispensable for their operation.

CENTRAL HEATING SYSTEM

Central heating as a means of conserving fuel was suggested, the system being burning coal at a central point and piping the heat to those who would otherwise burn coal. This heat can be piped as high or low pressure steam or hot water. Such a system as applied to Toronto, covering the business section, would save in coal $100,000 per year. A prediction was made that within ten years powdered coal would be transported and piped replacing bituminous coal in cars.

Railway electrification offers great theoretical promise of conservation by saving coal and by increasing the capacity of tracks and terminals of congested railway districts. In the electrical energy for railway electrification, if obtained from water-power, all the coal otherwise consumed by steam locomotives would be saved. An electric locomotive does three and a half times as much work in ton miles as a steam locomotive. This question is, however, a highly specialized one, economic, financial and engineering, while the high cost of apparatus due to labor and other conditions prohibit the carrying out of railway electrification on a wholesale scale.

HEATING BY ELECTRICITY

As to the universal heating of buildings by electricity it was shown that it is economically out of the question today and a general use in the future is very remote. Two million horse-power would be required to electrically heat Toronto's buildings, housing a population of five hundred thousand people. Heat from bituminous coal is normally one-tenth the cost of heat from electricity. At existing prices one cent will purchase the following units of heat applied to buildings, anthracite coal 14,300 units, bituminous coal 24,000 units, oil 7,750 units, electricity 4,200 units, electric heaters now operate at one hundred per cent efficiency and the marvellous inventions frequently announced cannot improve them. The general electric heating of buildings should not be allowed, as at the present time, the power consumed should be used for munitions and for industrial purposes.

WATER-POWER DEVELOPMENT

Canada is recognized as one of the great water-power countries in the world. No country enjoys to a greater degree the benefits of cheap dependable hydro-power and no country has had that benefit more universally applied for municipal, industrial and domestic use.

Water-power must take a very prominent part if the best use of the varied fuel power resources of Canada is to be achieved, it was said. There must be evolved a national fuel-power policy which will realize the best possible co-ordinated and concentrated development for the use of all the fuel-power resources of the Dominion.

Cheap power promises to be one of the country's greatest assets in the post bellum industrial rivalry of nations for world trade. Canada's great fuel reserves supported by its water-power resources represent a sure source of cheap power and should guarantee Canada her share of world trade if these resources are availed of to their maximum possible advantage.

The Council has appointed a committee to report on the result of the Conference with a view to making recommendation to the Government regarding a Fuel-Power Policy for Canada.

Visit to Works

Arrangements had been made for delegates to the Conference to visit the plants of British Forgings, Limited, and Canadian Aeroplanes, Limited. Those who were more interested in the plant of the British Forgings, Limited, were taken there in automobiles, the party being in charge of Mr. E. L. Cousins, Manager, Toronto Harbor Commissioners, while the greater majority, under the direction of Mr. Willis Chipman, journeyed in a special car kindly provided by the Toronto Street Railway Company, to the plant of Canadian Aeroplanes, Limited, on Dufferin Street. The entire works were visited, under the direction of the management, and were a revelation even to such a group of technical men, who are constantly in close touch with industrial affairs. Here was found one of the most modern plants in Canada, turning out the latest product devised by engineering skill, everything necessary to the finished aeroplane being manufactured in the plant with the exception of the engine.

First Professional Session

In his opening remarks at the first session held in the Chemistry and Mining Building, University of Toronto, the President, Mr. H. H. Vaughan, who presided, expressed his pleasure in being able to welcome so many to the first general professional meeting of the Institute which had been brought about in accordance with the new programme and in the hope that it was only the first of a series of successful meetings to be held throughout Canada in the future. "The meeting today," continued Mr. Vaughan, "is to be devoted to a series of papers on a subject that is a very live one for all of us at the present time, the fuel question, and a subject that is of peculiar interest to the Province of Ontario which, while practically without fuel supply of its own, yet possesses the greatest power system of any country in the world."

Sir William Hearst, Premier of Ontario, was welcomed by the President, who expressed the appreciation of the members present at having the privilege of hearing an address from the Premier.

Sir William Hearst, who was received with applause, said: "Mr. President, it gives me very much pleasure on behalf of the Government and the people of Ontario to welcome to Toronto, our capital city, the Canadian Society of Civil Engineers on this their first professional meeting. It would give me a great pleasure to welcome such an eminent body of scientific men under any circumstances or to deal with any subject, but it adds interest and it adds pleasure to welcome you on an occasion when you have met to discuss the subject just referred to by your President, that of fuel, in which this Province is so vitally interested—a subject that the Government is taking into consideration, a subject on which some very important and aggressive steps must be taken in order to meet the situation. It is not a comfortable position for a country to be in to be dependent entirely upon—not only the comforts but what is necessary to maintain life in a climate such as we live in, upon a foreign country, no matter how friendly that country may be. We are glad to know that in this regard we are at the present time depending upon an Ally, a country fighting side by side with us in the great battle for liberty. I hope, as I am sure you all do, and I believe that the Union Jack and Stars and Stripes will for all time to come float in the breeze as the symbol of liberty—(Applause)—the flag of the two great English speaking nations of the earth. But, nevertheless, it is important for us to be as independent as we possibly can, particularly with regard to these things that are vital to our happiness and to our very life.

The question of fuel in the Province is one that has been brought sharply into review since the war commenced, being brought out, in part at all events, by the conditions through which we are passing on account of the war. But it is a problem that the end of the war will not solve, and we should look ahead not only for a year or two years or whatever time the conflict may take, but we should look ahead and plan for all time to come with reference to the subject.

As your President has indicated, while in the Province of Ontario we have not discovered coal, nor have we any very good ground upon which to hope that we will discover coal of a commercial value, we have a great supply of water-power, and it is important that we should conserve that asset and develop it in the best manner possible for power and for such heating purposes as well as it may be adapted for. We also have great deposits of peat that up to the present time have not played any part in furnishing fuel to this country, as peat has not as yet been able to compete with coal under the terms that we have been able to get it in the past. That seems to be a very live problem that we should give thought to the best manner to treat it and to what extent it may be made use of for fuel purposes in this country.

My Government at the last Session passed a Fuel Act, providing for the appointment of a Fuel Administrator or Controller, making appropriations for the service and having power to experiment and to develop the peat deposits in the Province. Already an arrangement has been made with the Dominion Government whereby experimental work will be carried on this year in co-operation between the two governments, that we may test as well as we can not only the value of some of the deposits—they are fairly well-known—but the best manner in making that commodity available for fuel.

The whole question of fuel distribution is one that is now the subject of discussion and arrangement between this Province and the Dominion, and one that requires the very best thought and consideration. Even the deposits of peat, no matter how good they may prove to be, will not meet the requirements of the coming year, because it would be impossible to have these deposits available. So we have to consider the question of wood fuel and the whole question of disposition of fuel throughout the Province so that the least inconvenience and hardship may be suffered during the coming year.

We are particularly glad, therefore, that a gathering of this kind should take place where we can have the benefit of the discussions, deliberations and suggestions of so eminent a Society as yours on all these questions. The Government will look forward with great interest to what your decisions and suggestions and advice may be, and I am sure we will gain from that great assistance in trying to do our part in solving this great problem. This is a time when we are all called upon to give thought and consideration to public questions. If there ever was a time in the history of the world when everyone's brain and strength and arm should be at the service of his country this surely is the time. (Applause.) And it is a very encouraging sign to see the men of your profession willing to give up—for you are all busy men—the length of time that you have set apart for the study of such an important and, in fact, such a vital question to this Province and to this country.

I am not going to take up your time further. I have to go away now, as this is the day in which we prorogue the House. I only want to extend to you again a welcome on the part of the Government and people of the Province, to wish you the utmost success in your deliberations and to assure you of the assistance of the Government in your work and our desire to co-operate with you in accomplishing the things that you have in view. We are passing through a trying test. It is not necessary for us in words to urge men in this country to do their best for the King and for the Empire and for civilization. The needs of the hour speak louder than any word can possibly speak. Our hearts are heavy this afternoon as we think of the sacrifices being made on the Western front for us and for liberty. It may be that we require this extra chastening in order that we people in this very country so blessed of God may fully understand and appreciate the demands made upon us to consecrate ourselves more than we have to the service of freedom and to the service of our country. Surely we are getting that lesson now if we need it. But while the clouds are dark and lowering, I have no fear of the result—whatever lackness there may be at home there is none on the part of the men that are keeping the Western front. They may die but they will never yield and the Hun will never completely break that line is my firm conviction. (Applause.) While, as I have said, the clouds are dark, the darkest hour is often just before the dawn, God reigns on high, and truth, righteousness and justice will prevail, and whether the victory be early or be long it will be, I am confident, that victory will come to the Allied cause and the forces of freedom will eventually prevail. God grant that will come even sooner than the present indications present."

The Premier's address was received with considerable applause, after which the President extended the thanks of the meeting to the Premier for his kindness in being present. Continuing, Mr. Vaughan said:—


Group Showing Members Attending First Professional Meeting

"Gentlemen, on a day like this on which such momentous events are transpiring in the world, it seems out of place to congratulate ourselves on our first meeting, but at the same time we are entering on a rather new stage in the development of our Society, and I do feel that the Ontario and Quebec branches should be congratulated on the programme they have succeeded in getting together for this meeting, and I know that I personnally feel particularly gratified in seeing such an excellent attendance here today.

As you know, these professional meetings of the Society were organized as a result of the deliberations in the Committee of Society Affairs that has been working for the last two years, and I really think that if they can be carried out successfully and meetings held from time to time in different provinces, that if the Committee on Society Affairs did nothing else they certainly have done something that will instil life and interest into our Society. Nothing

is going to do us more good as engineers than to get together, meet each other, visit works of interest and have an opportunity to read and discuss professional papers periodically—something that should be attained by these meetings, of which this is the first.

We as a Society, I think, are very much indebted to the Officers of the Ontario branches, the Toronto branch and the Ottawa branch, for the amount of work they have done to get this meeting started. And while the meeting is not over, and it is perhaps too early to congratulate ourselves on the success of it, I feel sure that what they have done and the attendance we have here with us today means

Professor PETER GILLESPIE, M.E.I.C.

Member of Council E.I.C., Chairman, Toronto Branch.

that we can feel that our first professional meeting is a successful one and we should certainly be thankful to these men for what they have done to get it started.

The first order of business on the programme is the reading of a paper on "The Fuels of Canada," by Mr. B. F. Haanel, Chief of Fuel Division, Department of Mines, Ottawa. If Mr. Haanel is here I will ask if he will kindly come forward and read his paper."

The Fuels of Canada

Mr. B. F. Haanel, Chief of Fuel Division, Department of Mines, Ottawa, read his paper "The Fuels of Canada" which had already secured such favorable comment throughout Canada after its presentation at the annual meeting in Montreal. Mr. Haanel's paper has already been printed in advanced proof form and appears in full in the report of the annual meeting.

Following the address of Mr. Haanel, the President pointed out that this meeting was giving an opportunity to those who were fortunate enough to be present of listening to an exceptionally select collection of papers, the programme of which embraced the subject, under discussion, in three sections. "You will notice," said Mr. Vaughan, "that we have papers on 'The Fuels of Canada' which you have just heard," "Transportation from the Fuel View-point," "Utilization of Peat," "The Low Temperature Carbonization and Briquetting of Bituminous Coals,"—all subjects that belong more or less to the distribution and development of our fuel supply. Tomorrow morning we start with "Ontario's Efforts to Relieve the Fuel Situation," and "Wood as an Emergency Fuel." These things lend themselves to the immediate future; whereas the former set of papers are more directed to the general situation in Canada and its future development rather than to the immediate emergency. We then come to a set of papers, "Gas for Light, Heat and Power," "Central Heating as a Means of Conserving Fuel," "Oil Fuel and the Possibilities of its use," "Canada's Water Powers and their Relation to the Fuel Situation," "Railway Electrification," "The Possibilities of the Relief of Fuel Consumption in Canadian Industry by the Increased use of Hydro-Electric Energy," "The Possibilities of Lessening Fuel Consumption in Canada by the Adoption of Electrical Heating,"—all of which are really, generally speaking, substitution papers—that is, substitution for coal as a source of power. I think if we take the papers straight through this afternoon, first five papers, and then start the discussion on them as a unit we shall get along better than we will if we have a discussion following each paper, because these papers are so interlocked and cover the same subject to such a large extent that any discussion on one paper will inevitably encroach on the discussion on the other."

In the absence of Mr. W. M. Neal, Mr. Button read the former's paper on

Fuel from a Transportation Standpoint

No gentleman in this room needs to be reminded of the close and intimate connection between the humble coal pile in his cellar and the pride and comfort of the loftier apartments in his house. We may in the past have treated the coal bin as a mere poor relation or humble servant. We gave it the poorest room in the house. We even hired other people to attend to it so as not to have to soil our fingers by contact with the fuel problem, but nowadays I think one can observe a much more kindly attitude toward this humble factor in our domestic arrangements. We have been forced, as it were, to enter into diplomatic relations with the coal bin and to treat it with consideration and very great respect.

The greatest coal bin in the Dominion of Canada is the coal bin of the railway companies. Many of you, gentlemen, have seen some of the young mountains of coal which the transportation companies are forced to maintain at their terminal points. There are in Canada over 5000 locomotives whose appetites require an average ration of from one hundred to one hundred and sixty pounds of coal for every mile run. The engine which drew some of you gentlemen from Montreal to Toronto last night burned not less than sixteen and a half tons of bituminous coal. If we allow that the average tender on the average engine holds ten tons of coal, then the requirements of the railways for a single loading of their tenders amount to

over fifty thousand tons. The total coal consumption of the railways of Canada in the last year for which Ottawa gives official figures (1916) was 8,995,123 tons which cost them $27,961,186. This was almost as much as the total Canadian import of bituminous coal and slack in the same year.

But, of course, what the railways themselves consume is only the beginning of the coal problem for the Railway Managers. Although we imported only about 9,000,000 tons of bituminous coal and slack in 1916, the railways hauled that year 18,122,835 tons. In addition to this they hauled 7,057,628 tons of anthracite coal and 1,772,854 tons of coke. The hauling of fuel both for themselves and the public amounted to approximately 25,000,000 tons, or over one-fifth of the total freight tonnage carried by all the railways of Canada that year. It was four times the weight of the ore carried and twice the weight of the total products of manufacture which were carried by the railways. It required the service of 29,948 trains of 23 cars per train, or the exclusive service for one year of approximately 1000 freight engines and 23,000 freight cars.

The weight of bituminous coal carried by the railways runs, as a rule, just a trifle less than the weight of all the grain produced in the Dominion.

I give you these figures to impress upon you the *extraordinarily* intimate connection between the coal situation and the railways of Canada. I cannot refrain from remarking, just in passing, that although coal carrying represents such a great part of railway work, it does not represent a proportionate part of railway earnings. Coal is carried farther in Canada for less money than in any other country in the world. It costs the coal dealer less for the freight on a ton of coal transported sixty miles than to team that same ton one mile in the City of Montreal or Toronto. The recent rail rate increases give the railway about 15 cents per ton more than before on an average anthracite shipment from the mines to Toronto. One hears a great deal about this increase yet the general increase of 66⅔% in teaming costs due to increased price of oats, labor and horseflesh has scarcely been mentioned in the public press.

Now I intend first of all to outline roughly the machinery of coal distribution in Canada as it existed before the war. It is necessary to divide the country into five districts according to the fuel situation in each. I will then try to show what each district used, where it obtained its supply and how.

Starting in the east let us define District Number One. It reached from Halifax, to, say, Montreal. It was supplied with bituminous coal from the Nova Scotia and Cape Breton Mines. This coal was distributed partly by rail, but chiefly by boat. In 1913, the last normal year, the Dominion Coal Company distributed 1¾ million tons by boat in the St. Lawrence alone, and the Nova Scotia Steel Company another ½ million. The famous, or infamous Storstadt, which sank the Empress of Ireland, was one of the fleet of vessels distributing this coal. Very little of it, I might say, was consumed farther west than Montreal. Nova Scotia and New Brunswick consumed quantities in addition to the St. Lawrence requirements. Much of this, also, before the war was carried by steamer or by the humbler but more picturesque schooners of this region.

District Two, overlapping District One to some extent, reached, one might say, from Quebec City and towns like Sherbrooke, P.Q., and St. Johns, P.Q., West to Windsor and Sarnia and North to Sudbury, North Bay and Cochrane. This was, and is the great coal importing area of Canada. It is here that the major portion of our anthracite coal was consumed and the chief share of bituminous coal was converted into energy and manufactured goods. It came by three different means (1) by rail (2) by water and (3) by car-ferry. The chief *rail* points from which coal passed directly into Ontario were Black Rock, Victoria Park, Suspension Bridge, Niagara Falls and Bridgeburg. These are the points we call the Niagara Frontier—where special precautions had to be taken this past winter as I shall describe later on.

G. GORDON GALE, M.E.I.C.
Chairman, Ottawa Branch.

Another direct rail connection from District Two to the U. S. is, of course, at the Soo but no coal of any account passes here.

Of the car-ferry connections the largest are at Sarnia-Port Huron and Windsor-Detroit. A considerable amount of Illinois coal passes here. Much more crosses Lake Erie from Cleveland to Port Stanley; Ashtabula to Port Dover; Ashtabula to Port Burwell; and Lake Ontario from Ogdensburg to Prescott and Charlotte to Cobourg. I might say that practically the only traffic from Port Burwell is empty coal cars southbound and loaded coal cars north. This one little port accounts for 54 cars of coal per day in good weather.

So much for the direct rail connections and the car-ferries. There is still a traffic in coal schooners and steamers of a sort plying on Lake Ontario from Oswego to Kingston or Toronto, and on Lake Erie from the American coal ports to the Canadian ports I have just named.

These are the coal carrying connections between District Two and the American coal fields. The coal thus received is distributed chiefly from Toronto, Hamilton and London to the rest of the older parts of the Province.

In District Number Three let us place all the North Shore of Lake Superior West to the Eastern Boundary of Manitoba. In this region Port Arthur and Fort William are the central points. Another port of which little is heard is Jackfish, a C.P.R. point, where this company obtains enough coal by water during the summer to supply the North Shore Divisions all year round, without having to burden the line itself by hauling coal via Toronto and Sudbury. That, of course, is a digression from my point. The centres of public distribution are the Twin Cities. Many of the vessels which come north for cargoes of eastbound grain bring coal on the up voyage. This coal is scattered westward by the returning empty grain cars from Fort William to Winnipeg. How far west of Winnipeg this movement goes, I cannot say definitely, as it depends upon the production and movement of Western coal. Here the American coal coming up the lakes begins to come in competition with the coal from our Western foothills. The greater the production of western coal the farther east it comes.

J. B. CHALLIES, M.E.I.C.
Secretary-Treasurer, Ottawa Branch.

District Four might be said to include Winnipeg and the Eastern portion of British Columbia, overlapping District Three to some extent. In its most westerly extension it is fed almost exclusively from the Alberta coal fields.

Of District Five I need only say a word. This takes in the Western slope of British Columbia. The railways here use coal and oil fuel. The supplies of coal were and are from Washington and Nanaimo. The consumption is not large and the problem of distribution is not great.

There, Mr. Chairman and Gentlemen, you have the outlines of the fuel situation from a transportation viewpoint as it existed BEFORE the war. I will take now only a few moments to explain the changes which war has brought about in each District.

In District One—The steamers plying from Sydney to St. John, Halifax, Quebec and Montreal have, so to speak, enlisted. The distribution of coal from these mines falls entirely therefore upon the railways. The two million tons distributed by boat in the St. Lawrence are now carried by rail. The schooners on the coasts of Nova Scotia and New Brunswick continue to do their share, but even there the railways have had to assume an extra burden. I might add that this Eastern Canadian bituminous coal is now moving into District Two as far as Ottawa and Cornwall. The increased consumption of coal in District One has made necessary the use of American coal here too, which is hauled north via Montreal and then east.

In Districts Two and Three there have been two changes (1st) a falling off of water-carriage of coal on the lakes and (2nd) the congestion of the American roads which made it impossible to send the proper number of coal cars south for coal on account of the danger that they would be lost down there even before they could be loaded at the mines. The loss of the water-carriers was perhaps the more serious of these two considerations. From these three Districts a tremendous proportion of the water-carriers have disappeared. Practically the entire burden—amounting as I said to 2,000,000 tons or 50,000 carloads for St. Lawrence points alone— has been forced upon the railways. They met this condition by (1st) building more coal cars; (2nd) by converting sand and gravel cars for coal use; (3rd) by enforcing economy in their own use of coal; (4th) by pressing box cars into the coal carrying service and; (5th) by trying to move as much coal as possible in the summer season when the traffic may take advantage of easier transportation conditions. By a campaign among the big shippers asking them to accept coal deliveries last summer instead of in the fall much good was accomplished. With respect to the danger of losing our coal cars in the United States thousands of tons of coal were worked through the American tangle in returning Canadian "empty" box cars. The use of box cars for coal carrying can only be applied from mines and docks where there are devices for loading and unloading these cars with coal. Fortunately these devices are already established in the West, i.e., Districts Three and Four, otherwise we should have had a lot of trouble sending to Winnipeg special coal cars instead of using the West bound empty box cars.

I must make special reference to the work done on the Niagara Frontier this winter by the Administrative Committee of the Canadian Railway War Board. In this work all roads co-operated to the fullest extent. The incoming coal cars at Black Rock, Bridgeburg, Victoria Park, Niagara Falls and Suspension Bridge were forwarded rapidly to Hamilton, Toronto, London and other points without respect to what road they were routed by. In spite of blizzards and exceptional weather conditions about 5,000 cars (chiefly coal) were put through in a period of two months over and above what would have been regarded as a normal movement. This meant to the Canadian consumers about 150,000 tons of coal extra.

So much for Districts One, Two and Three. In District Four, that is from Winnipeg to the Eastern half of British Columbia the question is now being discussed whether the Western bituminous mines could not look after the bituminous requirements of that district while the lignite, being compressed into briquettes, might replace the anthracite. This is a consummation devoutly to be desired and members of the Canadian Railway War Board have already taken up the question with a view to being ready

as far as transportation is concerned to make Western Canada, by the winter of 1919-20, as nearly self-sufficient as possible. How far this is possible I cannot even guess, although one might mention some of the factors governing the situation:—

FIRST—as to production of both bituminous and lignite coal, the mines have never been able to turn out maximum quantities (a) because of labor troubles. High rates of pay enable men to take time off with impunity (b) because of lack of storage facilities for lignite coal.

But even with these much might be done, so far as the railways are concerned, by a concerted effort on the part of the mines, the railways and the public to persuade the consumers to place their orders for delivery during the slack months.

Conditions in District Five have not changed. There is some talk of having the Californian supply of oil fuel for railway locomotives cut off. This would be very serious for the railways, as the following figures show:—

Fuel oil consumed in British Columbia, 1917: Canadian Pacific received 48,763,554 gallons, and consumed 46,608,660 gallons. Grand Trunk Pacific received 6,350,840 gallons and consumed 6,303,500 gallons. Esquimalt and Nanaimo Ry. used 2,646,400 gallons. Pacific Great Eastern Railway used 1,638,000 gallons.

I have described briefly the changed conditions of the Canadian fuel traffic and how the railways have met these changes.

Just one word now about the special means of internal economy which the railways have undertaken with a view to economizing in their own use of coal. I might mention that in Districts One and Two the coal is poorer in quality (and higher in price) than ever before. This is due to the labor scarcity at the American mines where the product is no longer picked over as it used to be.

First, regarding passenger trains, the Canadian Railway War Board, and the individual railways before the Board was formed, have cut off trains whose total yearly mileage would amount to 12,000,000 miles. Assuming an average of one hundred pounds of coal per passenger train mile this means 600,000 tons saved.

Parlor and observation cars have been eliminated, except in cases where there are combinations of dining cars or sleepers.

Fewer sleepers are attached to night trains thus a greater use of upper berths is made and the wheel resistance of extra coaches is done away with.

The speed of all trains has been reduced to the point where a maximum of effort is obtained from a given amount of fuel. No train is allowed to run at excessive speed to make up time. This has always been a practice very hard on coal economy.

Special trains and the hauling of private cars, except at the request of Government Officials, have been done away with.

Even more important economies have been made in connection with the freight services. A campaign for heavier loading resulted in a great improvement. For example, in the movement of freight to St. John, during the month of January, 1918, as compared with January, 1917, the average load per car rose from 26.4 tons to 32.3, an increase per car of 5.9 tons. The saving from this improvement on this traffic alone that month was 1,313 cars and over 7,300 tons of coal. There was also a saving of the time of eleven locomotives and fifty-five engine and train men for that month, besides a great many shopmen, yardmen, car checkers, repairmen, etc.

The handling of less than carload lots of freight has been so re-arranged as to load the cars more heavily.

We are thus able to reduce the ratio between net weight and tare weight in any given train. The wheel resistance is lowered. The train is made shorter and can therefore be handled more promptly.

GEO. HOGARTH, M.E.I.C.
Secretary-Treasurer, Toronto Branch.

In the actual firing of the engines further economies have been effected in spite of the lower grade of coal available in Districts Two and Three. Expert firemen are sent out to show the less experienced men the best way of dressing the fires.

I might say that the old practice of burning worn-out ties on the sides of the railways has been discontinued since the war. In some districts it does not pay to haul these ties to places where the railway can use them. In these cases the farmers alongside the track or the railway trackmen are being given the ties for fire wood. The greater proportion of them, however, are taken to the shops and roundhouses. It was found impossible to saw these ties owing to the amount of gravel and grit with which they were impregnated. A device has been made which breaks the ties into appropriate lengths and they are now used under the boilers.

I do not think, Mr. Chairman, that there is anything that I can add to what I have already said. As a railway man I may as well tell you frankly that I take a great pride, along with my fellow railroad men, in the record which the Canadian railways have established, not merely in the handling of fuel, but in the handling of food, munitions and

domestic traffic. We have had two exceptionally severe winters. We have had labor shortage. Fuel has been scarce and of low quality. The nature of traffic and the direction of traffic has shifted and changed overnight in a manner sufficient to strain the resourcefulness of even the most alert railroad men in the world. Changes which I have indicated with regard to the movement of coal in Canada apply even with greater force to the movement of other commodities. The Canadian railways have moved hundreds of thousands of soldiers, eastbound and westbound, they have handled 75,000 foreign laborers passing from Vancouver across the continent en route to France. There have been some difficulties, but, on the whole, I think there have been fewer railway troubles in Canada since the war than in any other country in the world. It is perhaps unfair of me to take advantage of your good nature to add this word of praise for the railroaders, but I should be a very poor spirited and unenthusiastic railroader myself if I failed to mention it.

I thank you for your very kind and attentive hearing.

Mr. W. J. Dick, M.Can. Soc.C.E., Mining Engineer of the Commission of Conservation, Ottawa, then read his paper on

©The Rational Development of Canada's Coal Resources

In his annual address Sir Clifford Sifton, the Chairman of the Conservation Commission, drew attention to the manner in which the necessity for conservation, or national efficiency, has been impressed by the war upon all peoples, belligerent or neutral: "Among the most remarkable of its results has been the re-examination which each nation has been compelled to make with regard to its material resources. The gospel which we have been preaching for some years past has now been found to be the true gospel. It has been found by hard experience that national safety demands that the nation should not only possess resources but understand them and be able to utilize them economically. Whereas, a few years ago people listened to the discussion of this subject with polite but somewhat academic interest, they now know that no subject is of more importance to the national well-being, and that the lack of developed capacity to utilize every possible resource may in certain emergencies mean disaster."

All the civilized and progressive nations of the earth are to day anxiously taking stock of their resources. They have found that the practice of trusting to others for the necessities of civilized existence is fraught with danger and uncertainty. They have learned that a nation can only surely count on that which lies within its own borders and is capable of being guarded against forcible exploitation by enemies.

Value of Coal

Day by day it becomes more evident that coal is the mainspring of modern material civilization, it has of late years been found to yield by-products of inestimable value, supplying: gas for heating, lighting and industrial purposes, products forming the basis of the analine dye industry; various chemical products for use as fertilizers, disinfectants, drugs and explosives. Its importance to a nation has been well exemplified in the present war. Without it Germany could not have carried on the war as long as she has, and according to Ludendorf the success of the German drive in Italy was due in a measure to the shortage of coal in the latter country.

Let us see for what purposes coal has been used in the present war:

(1) As a source of power.

(2) Metallurgical purposes.

(3) As a source of tri-nitro-toluoene explosive.

(4) As a source of picric acid for the manufacture of lyddite and melinite explosives.

(5) As a source of ammonia for the manufacture of:

(a) Ammonal explosives.

(b) Nitric acid.

(c) Fertilizers.

(6) For the production of benzol as a fuel for use in internal combustion engines.

The value of coal has not yet been fully realized, and the progress of science, and the improvement in the arts, will tend to increase the supremacy of steam and coal. While hydro-electric energy will replace it to a certain extent in Canada, the dependence of numerous industries upon coal and coal products for their raw materials, ensures that coal will always be required on a large and increasing scale. Upon the exhaustion of the oil-wells all the petroleum products, which are now obtained from them, must, as far as possible, be obtained from products distilled from coal.

The industrial prosperity of Great Britain has depended largely on the development of her coal resources. In 1913, Great Britain supplied nearly three-quarters of the seaborne coal trade of the world. Both the United States and Germany export considerable quantities of coal by land, but, in normal times, their oversea exports are comparatively small. As regards the supremacy of coal as a source of heat and power and the impossibility of finding a substitute, Professor Tyndall states:

> "I see no prospect of any substitute being found for coal, as a source of motive power. We have, it is true, our winds and streams and tides; and we have the beams of the sun. But these are common to all the world. We cannot make head against a nation which, in addition to those sources of power, possesses the power of coal. We may enjoy a multiple of their physical and intellectual energy, and still be unable to hold our own against a people which possesses an abundance of coal; and we should have, in my opinion, no chance whatever in a race with a nation which, in addition to abundant coal, has energy and intelligence approximately equal to our own.

©Eighth Annual Report Commission of Conservation, 1917.

"It is no new thing for me to affirm in my public lectures that the destiny of this nation is not in the hands of its statesmen but in those of its coal-owners; and that while the orators of St. Stephen's are unconscious of the fact, the very lifeblood of this country is flowing away."

National Fuel Problems

General Situation.—The investigation for the International Geological Congress, held in Canada in 1913, indicated that the world's actual known and estimated reserves of coal of all kinds, available within a depth of 6,000 feet from the surface, aggregated 7,397,553 million tons, or, approximately 5,000 times the world's present annual consumption of coal. Of this estimated total reserve, 6.71 per cent is anthracite (over 80 per cent in Asia, mainly in China), 52.74 per cent belongs to the less valuable sub-bituminous class which includes all the lignites and brown coals. In geographical distribution, no less than 68 per cent of the total is in North America, 17.3 per cent in Asia, 10.6 per cent in Europe, 2.3 per cent in Oceania, and only 0.8 per cent in Africa, allowing 1 per cent for scattered deposits.

The distribution by countries is as follows:—16.4 per cent in Canada, 51.8 per cent in the United States, 13.5 per cent in China, 5.7 per cent in Germany, 2.6 per cent in Great Britain, 2.4 per cent in Siberia, 2.2 per cent in Australia, and 5.4 per cent in small deposits widely distributed over many smaller countries. As Canada and the United States have the largest reserves of coal it is probable that, when Europe's coal supplies are approaching exhaustion, many great manufacturing industries will centre in North America.

The coal deposits of Canada are second only to those of the United States in quantity, and compare favourably with those of other great coal mining countries in quality, quantity and accessibility for mining purposes. The known area in Canada underlain by workable coal beds is estimated by D. B. Dowling at 111,168 square miles, containing over 1,300,000 millions tons of coal. For convenience in classification, the coal-fields may be divided into four main divisions, as follows:—

(1) The Eastern Division, containing the bituminous coal-fields of Nova Scotia and New Brunswick.

(2) The Central or Interior division, containing the lignites of Manitoba and Saskatchewan and the lignites, sub-bituminous, bituminous and semi-anthracite coal-fields of Alberta and the bituminous coal-fields of the Rocky Mountains in South-Eastern British Columbia.

(3) The Pacific Coast division containing the bituminous fields of Vancouver Island, and bituminous and semi-anthracite fuels of Queen Charlotte island and the interior of British Columbia, and the lignites of Yukon.

(4) The Northern division, containing the lignites and low-grade bituminous coal of the Arctic-Mackenzie basin.

Production.—The coal mining industry of Canada has developed at a very rapid rate. In 1874, the earliest year for which there is a reliable record, the production was 1,063,742 tons. Twelve years later, in 1886, it had doubled; after twelve years (in 1898) the production had again doubled, 4,173,108 tons of coal having been produced. From 1898, the production rose more rapidly, and in six years the production was again doubled, amounting to 8,254,595 tons in 1904. In 1913, the production was 15,012,178 tons or an increase of nearly 85 per cent in nine years. In 1916 the total coal production of Canada amounted to about 14,500,000 tons.

Imports.—The imports of coal into Canada have increased faster than the production. In 1886, the imports amounted to 1,962,604 tons. Twelve years later, in 1898, they had increased about 70 per cent and amounted to 3,374,170 tons. From 1898, they increased very rapidly and, in six years, they were more than doubled, amounting to 6,936,959 tons in 1904. In 1913, the imports amounted to 18,201,953 tons, or an increase of over 260 per cent in nine years. In 1916 the imports exceeded 17,000,000 tons. Of the total consumption in Canada, during 1916, a little over 47 per cent was domestic coal and over 53 per cent was imported coal. In other words, we imported more coal than we produced.

The importance of this fact may be more fully recognized when it is considered that central Canada is dependent upon United States for supplies of coal to heat our dwellings and keep our factories and railways in operation. It is desirable, both from the mining and national standpoint, that these conditions be changed.

Distribution of Imported Coal.—United States bituminous coal is used in the area between a north-and-south line through Farnham, Que., and a line through Battleford to Moose Jaw and then to Estevan, Sask. Although a considerable quantity of this coal is used in Manitoba and Saskatchewan, these provinces are also supplied by coal from Saskatchewan, Alberta and British Columbia.

About three million tons of United States bituminous coal is used, principally as a locomotive fuel, in the area west of the Great Lakes. About ten million tons of this class of coal is used in Ontario and a portion of Quebec for locomotive fuel-power purposes and in the manufacture of coke.

Eastern Canada possesses no deposits of anthracite coal. As this coal is admirably suited for domestic and cooking purposes, it is imported in considerable quantity from the United States and is sold over an area extending from Nova Scotia, in the east, to Battleford, Sask., in the west. A little over 500,000 tons is used west of the Great Lakes and about 4,000,000 tons is used in Ontario and Quebec.

Fuel Oil.—Imported fuel oil is used to a considerabel extent in Western Canada. It is not possible to estimate to what extent it has replaced coal but according to *Railway Statistics* about 49,000,000 gallons were used on railways in this district.

National Fuel Problems and their Solution

An examination of the information presented will show that Canada's fuel problems may be resolved into the following:—

I. Domestic fuel problem in central Canada.

II. Railway fuel or transportation problem of central Canada and of part of western Canada.

III. Domestic fuel problem in Prairie Provinces.

IV. Cheap power problem of Prairie Provinces.

V. Railway fuel problem in forest areas in British Columbia and Alberta.

I. *Domestic Fuel Problem in central Canada.* The province of Ontario and a portion of the province of Quebec and Manitoba are dependent on United States for supplies of anthracite which is used as a domestic fuel. The anthracite resources of United States are limited and there is no assurance that export of this coal to Canada will be long continued. The maximum production has been reached and we must, therefore, expect that the price will increase year by year.

From the above it may be seen that before many years eastern Canada cannot be assured of getting supplies of anthracite coal from United States unless at a greatly increased cost; also that, as there are no supplies of this class of coal in the above mentioned area, we cannot expect to supply the need from our own resources.

Hence, we arrive at the conclusion that some kind of substitute must be developed to take its place. This may be in the form of bituminous coal, peat, electric energy or coke.

Any reform in the domestic fuel consumption should aim at achieving one or more of the following objects:—

(1) Actual reduction in cost of domestic heating, either in the form of direct saving of fuel or labour, or both;

(2) Mitigation or abolition of the domestic smoke nuisance.

Bituminous Coal.—This class of coal is mined in Nova Scotia and, during normal times, is used as far west as Montreal. Whether it could be used to any greater extent and thus replace anthracite coal in Ontario would depend on (a) its cost (b) supply. Even if a sufficient supply was available it would not be possible to market this coal in Ontario in competition with American bituminous coal imported through Buffalo or Lake Erie ports. The production of coal in Nova Scotia has decreased from 7,265,000 tons in 1913 to 5,657,000 tons in 1916 and it is doubtful whether the production can be increased to any considerable extent without recourse to the mining of thin coal seams which could be done only at increased cost; again, industries are locating in Nova Scotia, where the coal is, therefore the demand for coal in this province is increasing, hence there will be less available for shipment to other points outside the province.

As the question of the substitution of peat fuel and electric energy in place of anthracite coal will be discussed in other papers in connection with this meeting no further reference will be made to this subject here.

It would appear that for the present, at least, central Canada is, and will be, dependent upon United States for supplies of bituminous coal to replace anthracite as a domestic fuel. Bituminous coal may be used as an economic source of heat in large boiler plants without creating a smoke nuisance. This nuisance is a serious one when this class of coal is burned in the ordinary domestic furnace. Large economies may be made by the introduction of central heating plants producing power and the exhaust steam distributed for domestic heating. This would do away with the ordinary unefficient domestic furnace and it is believed that, to a certain extent, central heating will prove to be a possible solution to this problem.

Coke or Partially Carbonized Coal and Gas. – The Central heating plant as outlined above cannot completely solve the fuel problem. How then can it be solved? The gas companies are by nature and in fact public utilities. They manufacture a necessity which does not lend itself to competition. With some exceptions, the average municipal gas plant is a small and antiquated organization, both in practice and in vision, far behind the present possibilities of manufacture and application as indicated in Great Britain and Germany. Although the municipal gas plant now meets rather inadequately only a small share of the fuel needs of the community which it serves, it represents an established activity which can be converted into an organization that will supply all the fuel, whether gaseous or solid, that the community consumes. The transformation may retain the gas mains and much of the other equipment of the present type of plant, but in the place of the present procedure with relative neglect of by-product recovery will be substituted a by-product system of coal distillation, producing artificial anthracite, gas, ammonia, benzol and tar. This will mean in each city a centralized purchase and consumption of raw coal, and a centralized distribution of products. The output will be limited at first, at least, by the demand for solid fuel. A production of ample solid fuel will give an excess of gas over that now produced, which will call for an expansion in the use of gas, both in the home and in industry. Such expansion will come as a result of cheaper gas, incidental to the proposed plan of production, together with improvements in methods of utilization; and this very expansion will cut down the use of solid fuel and thereby hasten the adjustment. The three remaining first products, ammonia, benzol, and tar, have an unlimited field of usefulness as such, even with the municipality—the ammonia may be used as a fertilizer, benzol as a motor fuel, and tar as a road dressing. According to C. G. Gilbert and J. E. Pogue,* "It is not beyond the bounds of reason to foresee a condition whereby a householder, in the place of his ton of anthracite which he now welcomes for $11, will receive a ton of smokeless coal without slate, a month's supply of cooking gas, 40 miles of motor fuel, enough fertilizer to start a small garden, and tar sufficient to allay the dust in front of his house—all for less money than he now pays for inferior coal." This may appear a fanciful picture, but coal has precisely this possibility within itself.

The coke or artificial anthracite produced requires no change in the present types of furnaces and grates, is applicable to suburban and out-lying districts not served, or servable, by pipes and will always be in demand for open fires. The gas, on the other hand, eliminates the factors of storage and haulage, reduces dirt, and is more efficient. For industrial purposes, gas offers conspicuous advantages, as evidenced by the varied industrial use of natural gas in all regions where abundance of supply creates a favourable price.

The domestic fuel problem in central Canada is unique and the high price that we pay, and will continue to pay, for anthracite coal has not a parallel elsewhere. In other countries even where the price of coal is cheaper than here, coke affords a good substitute for bituminous and anthracite coal. As a domestic fuel, and for all industrial purposes, such as baking, drying, heating and steam raising, it is fully equal to anthracite coal, weight for weight, it lights quicker and holds the heat as well and its use is coming

**Coal: The Resource and its Full Utilization*—Bull. 102, Part 4. United States National Museum.

to be recognized as the only real and permanent solution of the smoke question. The extent to which it is used, even in the United States, where domestic fuel is cheap and where the development of by-products coking of coal is far behind that of European countries, is shown by the fact that 2,000,000 tons of coke were used in 1915 for domestic heating. For heating, particularly in household furnaces, it possesses many advantages and is rapidly coming into favour.

The ability of the gas companies to dispose of an inferior coke for similar purposes, when proper methods are used for its introduction, is further evidence of the field open for by-product coke in this direction.

In this connection it might be said that as it is lighter than coal it requires a somewhat larger fire box, but the space in ordinary furnaces, on account of them being designed for the extreme weather, is usually ample.

The following is an extract from the Proceedings of the Engineers' Society of Western Pennsylvania:

"A considerable trade is being built up in certain districts in domestic coke, which is usually the by-product article crushed and sized and distributed in the usual manner. It has been found very satisfactory for all fuel purposes where a little attention is given to its properties, as distinct from anthracite or bituminous coal. It is quite probable that the future will see considerable extension in this direction as the other products of coal distillation become more desired and justify investment in coking plants. In this connection it may be remarked that large quantities of coke are now consumed in Germany in place of coal, it being desirable to operate their by-product coke ovens for the production of ammonia and of benzol, toluol, etc., although the coke is not specially required."

Coke as a Boiler Fuel

Economic Aspects.—"When new boiler installations are contemplated it is rarely that the influence of the fuel and the proposed draught system on capital expenditure is taken into consideration. With broken coke and an impelled draught the height to which the chimney shafts need to be taken may be considerably curtailed, with a corresponding reduction in outlay. In the past, steam-generating plant has invariably been designed on the assumption that some variety of hard coal will be the staple fuel employed. A series of figures recently compiled from practical observation are of particular interest from the point of view of present-day conditions. As regards four of the most common fuels, it has been calculated that with coal slack at 25s. per ton, mechanically stoked, the cost of evaporation per 1,000 gals. of water amounts to 14s. 11d. With hard steam coal at 35s. per ton the cost of evaporating the same amount of water is 16s. 5d.; with smokeless Welsh coal at 38s. per ton the cost is 16s. 1d.; and with coke at 25s. per ton, burnt under impelled draught, 12s. 4d. The recent report issued by the Deptford Borough Council, relating to a trial period of coke firing with impelled draught in lieu of a high-grade coal having a calorific value of 15,000 British thermal units per lb. and only 3 per cent. of ash, shows that in the average working expenses for a single month there was a saving in favour of coke amounting to 16 per cent.

Use in Marine Practice.—"As regards the use of the newer fuel with marine boilers, it is a significant fact that three of the large colliers owned by the South Metropolitan Gas Company are now running entirely on coke, while the whole of the company's tugs are fired in the same way. Coke fuel was adopted many months ago on the now famed collier "Wandle". An interesting phase of the coke situation was the employment of this fuel by the National Steam Car Company for steam raising on motor-omnibuses. Unfortunately, just as promising headway was being made with the scheme, the works of the company became officially controlled for war purposes, with the result that little more could be done in the matter. It is understood, however, that the project has not been allowed to rest, and an improved motor of entirely new design is only awaiting less strenuous times before being put on to the road."*

Tests carried on by the United States Bureau of Mines© show that coke has a higher relative fuel value for use in house-heating boilers. The efficiency obtained with coke in sectional boilers was 61 per cent as against 59 per cent for anthracite; in vertical boilers the efficiencies were 55 per cent and 51 per cent respectively.

The cost of evaporating 1,000 pounds of water with coke and coal was as follows: (Assuming each cost $6. per ton).

	Sectional Boiler	*Vertical Boiler*
Coke	$38.28	$43.14
Anthracite	39.00	44.76

Several factors determine the selection of the process for the manufacture of gas. The old type of bench retorts for making coal gas requires a high grade of gas coal and produces a rich gas suitable for illumination, but the coke is soft and unsuited for metallurgical purposes. This kind of plant is relatively expensive, and is gradually being discarded in favour of water gas plants and of by-product coke ovens. Besides yielding an inferior coke, the coal-gas process is expensive to operate at a *distance from the supply of gas coal* because of *transportation charges.* The by-product coke oven which, in addition to its more economical operation, produces a coke that is suitable for blast furnace and foundry and domestic heaters, is replacing the old-style bench retort as a source of gas for municipalities, and in the United States in 1915, of 44 installations of ovens of the by-product type, 13 sold all or part of their surplus gas for city supply.

In concluding this phase of the question, the writer is of the opinion that carbonization of coal in the manner outlined is the rational solution to this problem. Such a plant established in the city of Toronto to supply 300,000 tons of artificial anthracite per annum would, not only provide such a fuel cheaper than anthracite, but would supply 1,500,000 M. cu. ft. of gas at a cost of 10c. at the plant; again, based on pre-war prices for cost of plant and bituminous coal, the profit on the undertaking would be considerably more than 50 per cent per annum.

II. *Railway Fuel Problem in Central Canada.*—United States bituminous coal is used as a railway fuel in the area extending from Montreal in the east to Swift Current, Sask., in the west. It was been shown that there is little likelihood of Nova Scotia coal being used to any considerable extent is Ontario. In so far as the western portion of the area is concerned there could be a considerable reduction made in the use of United States coal by the substitution of Alberta and British Columbia coals for that now imported. This is solely an economic problem and the existing conditions are due to the freight traffic being principally from the west towards the east. The coal is shipped as return freight, consequently a more favourable freight rate applies on the

*The Times Engineering Supplement.

©Bulletin 27.

shipment of United States coal from Port Arthur westward. Canadian coal could be used to a greater extent, if storage facilities were provided for in Winnipeg and other points, and a more favourable freight rate secured during the period when cars are not being used to any considerable extent in the movement of the grain. This period is from February to September, which is usually the slack period for the mines, so that if such an arrangement could be made, it would not only be of advantage to the operator, but would also be the means of assuring more stable labour conditions. The latter is by no means the least important result to be accomplished in connection with the coal mining industry in western Canada.

The railway fuel problem in Ontario can be made independent of foreign sources of supply only by means of electrification of railways, or the use of powdered peat as a locomotive fuel. Economies may be made in the use of imported coal by the burning of it in the pulverized form. The saving may amount to 25 per cent of the total now used, but the capital cost necessary for its general use on locomotives would be large. Electrification of the railways, carried out step by step would appear to be the reasonable solution, from a national standpoint, of this problem.

III and IV. *Fuel Problem in Prairie Provinces.*—The following table gives the total imports of coal into Fort William, Port Arthur and Manitoba, Saskatchewan and Alberta points of entry:

KIND OF COAL	AMOUNT, in tons			VALUE IN 1916
	1914	1915	1916	
Anthracite	612,161	485,330	533,642	$ 3,008,489
Bituminous Slack	145,960	222,769	258,836	326,326
Lump and run-of-mine	2,995,181	1,586,620	2,118,098	2,759,873
TOTALS. . , .	3,753,305	2,294,719	2,910,576	$ 6,094,688

The above valuation of the coal imported is based upon the price of coal at the mines in the United States and does not include freight charges on American railways or the freight rate up the Lakes. The total amount of money which goes out of Canada to pay for these imports represents approximately $10,000,000. How then can these conditions be changed and the fuel supplied from our own resources?

A consideration of this problem of imported coal requires that it be discussed under two headings, viz.—anthracite coal and bituminous coal.

Anthracite Coal.—This domestic fuel is a luxury, not a necessity. Bituminous coal could be used in its place but the soft coal is more difficult to use. Consumers would rather pay a considerably higher price for anthracite and thus have less dirt and trouble in firing domestic furnaces.

Bituminous Coal.—The imported bituminous coal is used, largely, for railway use but a portion is also used for ordinary power purposes.

In connection with the above problem it might be said that the coal mines of Alberta and Saskatchewan have capacity for producing some 15,000,000 tons of coal per annum. This fact is of importance when it is considered that the actual production of coal in these provinces does not exceed 5,250,000 tons. There is no doubt, even under existing conditions, but that the production could be increased some 4,000,000 tons if the demand should warrant it.

It would be less difficult to replace the anthracite coal than the bituminous coal now used by the railroads.

Anthracite coal could be replaced by:

(a) Carbonizing and briquetting of lignite or bituminous coal.

(b) Coke from by-product ovens.

(c) Briquettes, made from slack coal of medium or high grade.

The imported bituminous coal could be replaced to a considerable extent by:

(a) Educating the users to the methods to be adopted for the economic utilization of the various grades of coal produced in the west.

(b) Establishment of central plants using automatic stokers or producer gas.

(c) By the thorough cleaning of the coal before marketing. This is most important as the freight charges are a large item of the cost of the coal at points long distant from the mine.

The impurities (high ash) upon which the freight also applies, not only constitute so much valueless product but it lowers the efficiency of utilization of the coal. In this connection it is of interest to note that when the ash content exceeds a certain figure, every one per cent increase is equivalent to two per cent loss due to ash and when the ash content amounts to 35 or 40 per cent the coal is worthless as it is difficult, if not impossible, to keep it ignited in an ordinary furnace.

V. *Railway Fuel Problem in Forest Areas in British Columbia and Alberta.*—The coal reserves of Canada are considerable, but a large proportion is unsuitable for use in the ordinary way as locomotive fuel. The coals of Manitoba, Saskatchewan and portions of Alberta are lignite or sub-bituminous coal, high in moisture, and cannot be used as locomotive fuel on account of the liability of setting out fires from excessive sparking. Suitable coals were used on the transcontinental railways in British Columbia, but the development of the oilfields in California was the means of placing fuel oil in competition with these coals. Another contributory factor which indirectly encouraged the use of fuel oil was the fact that legislation placed the onus of proof upon railways for fires originating upon their right-of-way. The adoption of the use of fuel oil on railways meant that the expenses for fire patrol, damages, etc., could be largely eliminated. From this brief explanation, it can be seen that the most desirable markets for the coal produced in this area were not to be had.

A consideration of the possibility of obtaining these markets and the further extension of existing markets must, necessarily, review and determine the status and future of the use of oil fuel on western railroads.

Let us see what conditions are at the present time:

(1) The maximum production of oil in California has been reached, and the production is being kept up to a high level by the fact that more wells are drilled and operated year by year. As no new fields have been developed there is therefore a limit to how long this can be kept up.

(2) Owing to the introduction of new processes for "cracking" oils, more gasoline and less crude is being produced each year.

(3) The following shows how the increased price for fuel oil will be the means of prohibiting its use for ordinary purposes, as a fuel under boilers. In 1911 the

price was $0.447, in 1912—$0.454, in 1913—$0.467 and in 1914—$0.482 per barrel. In the latter year there was a greater production, and in 1915 the average price per barrel was $0.422. It was in this year that a number of the railroads used oil extensively in preference to coal. In 1916 the consumption increased rapidly until it exceeded production. In 1916 the price advanced quite steadily, closing the year at 68 cents per barrel. By May, 1917, California prices advanced from 78 cents to 88 cents according to the field and specific gravity; by June, 1917, the prices rose from 88 cents to $1.22. Recent advices from Seattle are that the price there has reached $1.75 per barrel.

(4) The question might be asked whether these conditions (in No. 3) are due to the war or not. After the war, presumably the consumption of fuel by naval vessels, military air craft, motor vehicles, etc., will have dropped to a moderate figure. On the other hand, the war will be the means of stimulating its use in air craft and the merchant marine. This will continue indefinitely, and there is little doubt but that fuel oil will be used in steamships on the Pacific coast in preference to coal, especially since at the present time, suitable coal can be obtained only from Vancouver Island.

(5) Having regard to the price paid by the railways of western Canada for fuel oil, the writer has no hesitation in saying that the higher prices which it will be necessary to pay in renewing contracts for fuel oil will be the means of causing the railroads in British Columbia to revert to the use of coal as a fuel in some form or other.

Pulverized Coal as a Locomotive Fuel

During the past three years, the progress in the art of adapting pulverized fuel to locomotive use has been such that it is now a generally recognized fact that in so far as the generation of steam, and the development of fuel boiler and engine power is concerned, success has been attained. The following steam railways have one or more pulverized fuel burning locomotives:

Deleware & Hudson
New York Central
Chicago & Northwestern
Missouri, Kansas & Texas
Atchison, Topeka & Santa Fe
Central Railway of Brazil
Swedish State Railways

The generally obtained results on the above-mentioned railways substantiate the fact that this method of stoking and burning solid fuels has now passed out of the experimental stage.

This class of fuel has been used to a considerable extent for a number of years in connection with the cement industry, metallurgical treatment of ores, stationery boiler plants, annealing furnaces, etc.

The use of pulverized fuel on locomotives would be attractive in the forest regions where, at present, the railways as an economic policy burn fuel oil. On account of our large imports of fuel oil, which has recently increased in price, anything that can be done to increase the efficiency of generating power from coal or economically curtail the use of fuel oil by the substitution, from our own resources, of coal or lower grade fuels should be encouraged as much as possible. Pulverized coal as a locomotive fuel has many advantages over the old method of firing and, owing to the increase in the price of coal, the economy resulting from its use will be the means of causing its general adoption.

In 1916, three carloads of coal—one from Bankhead, one from Canmore and one of Bienfait Lignite—were forwarded to the Deleware and Hudson Co., at Olyphant, Penn., for test in pulverized form. The following is the result of one of the tests.[⊙]

"On October 15th, a mixture of 50 per cent lignite and 50 per cent Bankhead (anthracite) were used. This mixture and adjustment gave the best results of any tried. The steam pressure ranged from a minimum of 195 lbs. to a maximum of 205 lbs., with an average of 201 lbs. The locomotive was worked as hard as it ever has been over the heaviest pull and could not be knocked out of steam' at a speed of 20 miles per hour. The smoke ranged from 0 to 1, as recorded by a Ringlemann chart, and at the end of a 6½ hour run, about one quart of slag was found in the slag-pan, and 5 flues were closed to the flue sheet. The heaviest pull made was 11 miles, with about 7½ miles of .7 per cent ruling grade and 2,287 adjusted tons in 39 loaded and 5 empty cars. The results from these tests are sufficiently conclusive to demonstrate their practical and economic usefulness, when properly prepared and burned, and enables the prediction to be made that these Canadian fuels will be brought into early and extensive use for domestic consumption in the generation of steam, as a substitute for the higher priced fuel oil and imported coals."

Waste in Coal Mining Operation

Any step towards the rational development of our coal resources must, not only include the utilization of coal efficiently and for the purpose for which it is specially suited, but it must also provide for the 'mining' of the coal in such a manner that as high an extraction as possible, based on total coal, may be obtained eventually at the minimum cost to the nation.

The waste of coal in connection with coal-mining in Canada, has been enormous. As much of our coal, not now available, is remote from transportation, only the exercise of careful conservation will enable us to keep the price, and therefore the more universal use of coal, near present levels. The gradual deepening of our mines and the opening up of new ones in less favourable localities, cannot but increase the price of coal and thus effect changes in our industrial condition. It is not urged that we should interfere with the free development and use of our coal resources, but that our duty lies in the earnest and wise application of knowledge to their development and use. The system of indiscriminate leasing of coal, now in use in the west, tends to increase the waste of coal; again, mining is so widely scattered and unorganized that destructive competition has been the means of destroying industry.

The individual companies are small and financially weak, new developments of slow growth, and coal is mined, in many places, in a haphazard manner. No system of storage is provided and the average mine can operate only when railway cars are available. Many mines close down in the summer months or during the slack periods, with destructive effect upon the conditions and supply of labour. These conditions could be obviated and the coal industry placed upon a sound basis by a pooling of interests or formation of industrial trade boards representing the industry.

[⊙]Locomotive Pulverized Fuel Co., Montreal, per J. S. Coffin, Jr.

Destructive competition is incompatible with economy, because coals expensive to mine cannot compete on a commercial basis with those which may be mined cheaply. The tendency is, therefore, towards the mining of the easiest available coal. If, on the contrary, leases were issued providing for the mining of coal in such a way as to prevent wasteful methods then competition would be on a fairer basis. It may be asserted that we should mine the easiest available coal first and then later, when necessary, turn to the coal more expensive to produce. This is impossible as the two occur intimately mixed and the geological conditions are such that in order to recover as large a percentage of coal as possible a definite order must be followed from the beginning.

Mr. John Blizard, A. M. Can. Soc. C. E., Technical Engineer, Division of Fuels and Fuel Testing, Mines Branch, Department of Mines, Ottawa, followed with his paper on

Utilization of Peat as a Fuel

There is no doubt that peat fuel will soon play a prominent part in the supply of Canada's fuel requirements. Exactly what part time alone will show; but the numerous and valuable investigations initiated by Dr. Haanel and undertaken by the Government enable its possibilities to be outlined.

The investigations are of three kinds. First, those which give information as to the quality, quantity of contents, and situation of the peat bogs; secondly, those dealing with the manufacture of fuel from the raw peat; thirdly, those dealing with the use of peat.

Peat investigation.—Peat is formed by the slow decay of vegetable matter in the presence of excess moisture. It varies in composition with its age, the conditions prevailing during decay, and with the vegetable matter from which it is formed. Thus, some forms of peat are suitable for moss litter, and others for the manufacture of peat fuel. When investigating a bog, the contents of which are suitable for fuel, samples are taken for subsequent analysis and calorimeter tests.

The quantity of peat available for fuel purposes is obtained by finding the average depth and area of the bog. But, since the profitable extraction of peat fuel by machinery is unlikely with an average depth less than five feet, the contents of the bog with depth greater than this alone are included in the estimate of the fuel contents. The weight of available fuel is calculated from the net workable peat fuel content, on the assumption that, on draining, the bog will decrease by one-fifth in depth, and that one cubic yard of drained bog will furnish 200 lbs. of dry peat. Thus, a bog one square mile in area with a depth of 10 feet will have a depth, on drainage, of 8 feet, and contain 800,000 tons of dry peat, or about 1,100,000 tons of air-dried peat, containing 25 per cent moisture.

The Mines Branch up to the present time has investigated about 300 square miles of peat bogs. The average workable 25% moisture peat fuel contents per square mile of these bogs amount to about 400,000 tons. The contents per bog vary very considerably. Thus an analysis of the results of investigating 27 bogs in Ontario shows the mean 25% moisture peat fuel content per bog to be 2⅓ million tons. The greatest content found in a single bog is 9 million tons, and some bogs contain no peat available for economical manufacture into peat fuel. The calorific value of the dry fuel in the workable Ontario bogs varies from 7,400 to 9,100 B. T. U. per pound, and the ash content from 4 to 26 per cent. The average workable peat fuel content of 10 bogs investigated in the Province of Quebec is 4 million tons per bog, and the maximum contents of a single bog 13 million tons. The calorific value of the dry fuel varies from 8,500 to 9,500 B. T. U. per pound.

Manufacture of Peat Fuel.—The outstanding difficulty in the manufacture of peat is the removal of its water content, which varies from 85 to 90 per cent in a drained bog. To obtain one pound of peat fuel containing 25 per cent moisture from raw peat containing 88 per cent moisture, it is necessary to remove $\frac{88-25}{100-88} = 5\frac{1}{4}$ pounds of water. It is frequently supposed by inventors and those not familiar with the economic and practical features of peat fuel manufacture that the most logical means of removing this large quantity of water is by submitting the peat to a high pressure. Actual experiments in pressing the water out of peat show that it is impossible, even with enormous pressures, to reduce the moisture content below 60 per cent. This would correspond to removing $\left(\frac{100-25}{100-60}\right)\ \left(\frac{88-60}{100-88}\right) = 4\frac{3}{8}$ pounds of the water. Since this $4\frac{3}{8}$ pounds represents considerably more than one-half of the moisture to be removed, it might appear that the pressing process should be persevered with. But past experience predicts that any scheme of this nature is doomed to failure.

Another scheme often suggested as a means of removing the water from peat is artificial drying. Unless an elaborate heat recuperation plant is installed, it is impossible to economically use manufactured peat to dry the raw material. The evaporation of moisture per pound of 20 per cent moisture peat burnt, with an ordinary simple drying plant, would be about 4 pounds. Thus, one pound of 20 per cent moisture peat would be capable of drying only about $4\frac{2}{3}$ pounds of raw peat from 88 per cent to 20 per cent moisture content. By this process the peat fuel production per pound of peat burned would be $\frac{2}{3}$ of a pound, and some fuel would have to be imported to carry out the drying operation.

The only economical means of removing the moisture from raw peat lies in exposing it to the wind and sun's rays. This is the universal method. It depends obviously on the weather, and the length of the manufacturing season is, for that reason, only about 100 days in Canada. Some years it is possible to prolong the season, and in other years the season will be less than the 100 days. It may be possible to prolong the season a little by undertaking a certain amount of artificial drying. This does not mean that it may become feasible to dry raw peat artificially. But it may be economical to dry artificially peat only partially dried by the sun.

There are only two methods by which peat is manufactured on a large scale. The first is the old and primitive method. It consists in cutting blocks of peat out of the bog by machinery or by hand; removing them, and leaving them to dry in the sun. The product is known as cut peat.

The second method of manufacture is more complicated than the first. Instead of keeping the blocks of peat intact, as in the cut peat process, every effort is made to see that each finished block contains peat from all depths of the bog, and that the raw peat is thoroughly mixed, pulped, and ground before drying. In very small plants it is sometimes customary to carry out the mixing and pulping by inducing horses or men to trample on the raw peat. In ordinary

plants a peat machine or macerator mixes, pulps and grinds the peat. The product of this method is known as machine peat. It is superior to cut peat, since, by mechanical treatment, the final air-dried product become less bulky, crumbles less, and is not so readily affected by rainfall while drying. Where there is lack of capital, or insufficient labour for the manufacture of peat during a whole season, it may prove profitable to manufacture cut peat for use near the bog. But there is no doubt that in any extensive exploitation of our peat bogs for the manufacture of peat fuel the product will be machine peat.

The preliminary work, on undertaking the manufacture of peat fuel, consists in obtaining a bog as free from roots and stumps of trees as possible, with a good depth of well humified peat, and with facilities for easy drainage. After selecting the bog, it is necessary to drain and level it in order to facilitate ease of transportation over its surface.

The actual manufacture of machine peat may be divided into five stages:

(1) Digging the raw peat out of the bog, and carrying it to the macerator.

(2) Mechanically treating the peat in the macerator.

(3) Transporting the macerated peat to the drying field.

(4) Spreading the peat on the drying field.

(5) Cutting the spread peat into blocks, and subsequently turning and stacking the blocks to facilitate drying.

The raw peat is either dug by hand, or by a mechanical excavator. If by the former method, a mechanical elevator conveys the peat to the macerator. If by the latter method, which is more suitable for Canadian conditions, owing to the high cost of labour, the peat is excavated and delivered to the macerator entirely by machinery. The mechanical peat excavator has to be carefully designed. It must exert a small bearing pressure per unit area of the bog, be easily moved, and cut a sloping wall from the top to the bottom of the bog in order to avoid future trouble due to possibilities of collapse of a ditch wall too nearly vertical. For the same output its lateral speed will decrease as its depth of cut increases. For a deeper cut a heavier machine is required, but for the same output it will move more slowly parallel to the ditch. Generally the peat drying field is parallel with the working ditch, and stretches back therefore a distance proportional to the area of the vertical section excavated per linear distance moved along the ditch. When the excavator arrives at the end of the working ditch, it must either be moved back to the other end, where by this time the peat should be dried and removed from the field, or, if it be intended to excavate on the return journey, means must be provided for transporting the raw peat over the peat previously left to dry, and on to the new drying field. To reduce the mean distance from the ditch to the drying field, it is necessary to use a ditch as long as possible, and to arrange for a machine which will arrive at the end of the ditch from which it started at the beginning of the season at a time when the first batch of peat has just dried and been removed. Thus, for a short ditch to obtain the requisite output, it would be necessary to choose a slowly moving machine with a deep cut, while, with a long ditch, for the same output a more rapidly moving machine with a shallower cut would be more suitable.

It has already been pointed out that the essential feature of manufacturing machine peat is the thorough mixing and pulping of the raw peat in the macerator or peat machine. One of the best types of macerator is the Anrep. It consists of two cylinders of different diameters, connected by a conical section. Raw peat passes in through a feed hopper, whose cross-section increases towards the machine to prevent arching. Below the hopper, it meets 6 double knives which rotate on a shaft, and can just pass between 6 fixed knives. The peat mass is thus subjected to a repeated shearing action. From the first cylinder the peat is propelled by helical blades to the second and smaller cylinder, wherein the shearing process is repeated, and, finally, the homogeneous mass is discharged from the machine by another screw through a spout. It sometimes becomes necessary to add water to the peat in this machine, when the raw peat is too dry for proper maceration.

The peat may be conveyed from the macerator to the drying field either in dumping cars which run on a portable track, or in buckets moving along a portable aerial cableway, or by other transportation devices. It is dumped on arrival at the drying field, either into wooden moulds, or into a spreader which is moved mechanically and lays the peat on the bog in long, narrow, parallel rows. The use of the latter method involves a further operation of cutting the rows transversely to form bricks. Circular knives, operated either by hand or mechanically, usually effect this. The two remaining drying operations consist of turning and stacking the peat. In drying, the peat contracts to nearly one-half of its linear dimensions. Its change, density, and imperviousness to moisture while drying depend largely upon its mechanical treatment in the macerator. The period of drying depends on the weather conditions and size of the peat blocks. The usual size of the blocks is about that of a building brick. If the blocks are too small in any one dimension, they lack strength; if too large, they take too long to dry.

As soon as the peat in the stacks is dried to about 25 or 30 per cent moisture, it is moved from the drying field, leaving room for the drying of more peat.

It is important to note that practically all the labour required for peat manufacture is unskilled, and that most of the turning and stacking on the drying field can be done by children.

Peat as a Fuel.—The investigation of the use of peat carried out by the Fuel Testing Division of the Mines Branch, Department of Mines, comprises producer and boiler trials; and a special inquiry into the use of peat in European countries.

The producer trials were carried out at the Fuel Testing Station. The plant consisted of a suction gas producer and gas engine of 60 horse-power. The fuel used came from the Government peat bog at Alfred, and from a commercial peat bog near Montreal. After redesigning the producer and adding a special tar extractor, both according to specifications of Mr. B. F. Haanel, the plant became a complete success, and previous troubles, due to the presence of tar globules in the gas, disappeared. A series of nine trials carried out at ¾ load showed a consumption of less than 30,000 British Thermal Units in the peat per kilowatt hour at the switchboard. This figure compares very favourably with even large power plants, wherein the corresponding figure with coal, steam turbines and boilers is about 20,000.

Commercial plants of this type have shown similar results. One, in Ireland, of 250 brake horse-power capacity showed to great economical advantage when compared with the former plant which used coal.

When it is possible to find a market for large quantities of power, the by-product recovery producer plant will be the more economical type to use. This type differs from those used for small powers, because it includes a costly plant for the recovery of the nitrogen in the fuel in the form of sulphate of ammonia. In this type of plant the producer itself is of very simple construction. The fuel is gasified at a comparatively low temperature to increase the ammonia recovery and no attempt is made to destroy the tar in the producer itself. The external plant consists of various washers, scrubbers, heat interchangers, and special towers for the fixation of the ammonia with sulphuric acid.

Peat is a particularly good fuel for this type of plant, because its nitrogen content is high. For a nitrogen content of 2 per cent it should be possible to obtain about 120 pounds of ammonium sulphate per ton of peat, which, at its pre-war price of $65.00 per ton, would sell for $3.90. The possibility of obtaining so high a return per ton of peat is of obvious importance, and has led to the installation of by-product recovery producer plants in Italy. The gas in these plants is burnt in gas engines, which drive dynamos, and electrical energy is sold in the neighbourhood of the plants.

There is no doubt that the gas producer is well adapted for the use of peat, and it is important to note that its moisture content will not affect the producer efficiency to the same extent that it does the efficiency of a steam boiler.

In a producer of the simple up-draft type the moisture for the most part has little more effect than to reduce the temperature of the gas, thus reducing the required quantity of scrubber water. In double zone types of producers, similar to the one used at the Fuel Testing Plant, the moisture passes through the fuel bed, thus rendering the producer independent of an external steam supply to enable the water gas reaction to take place.

To determine the steam-raising value of peat fuel with hand firing, a series of six trials were carried out in the laboratories of the Fuel Testing Division of the Department of Mines. The peat came from the Government peat bog at Alfred. Its moisture content was comparatively low, being between 15 and 20 per cent, while its net calorific value was between 7,000 and 7,500 B. T. U. per pound. Three of the trials were carried out in a water-tube boiler, with a heating surface of 677 square feet; the remaining three in a locomotive type of boiler, with a heating surface of 215 square feet.

The water-tube boiler trials were of more particular interest, since it was possible to compare the results of the tests with those obtained with coals which were burned under similar conditions. The coals varied in calorific value from about 8,000 to 12,500 B. T. U. per pound. The equivalent evaporation per pound of coal of about 12,500 B. T. U. per pound was about 8, while with peat the evaporation was about 4. The thermal efficiency with the coals was of the order of 60 per cent, and with peat about 53 per cent. The lower efficiency with peat is due to incomplete combustion of the gases, and to their high temperature on leaving the boiler. The loss due to incomplete combustion of the gases was about 7 per cent of the heat in the peat. The heat loss due to combustible in the ash was between 2 and 3 cent, a very low figure.

The trials with the locomotive type of boiler were carried out at rates of steaming of the order of 600, 800 and 1,000 pounds per hour; the corresponding thermal efficiencies were 53, 52 and 42 per cent. Again the conspicuous feature was the great losses due to unburnt gases, which were about 11 per cent for the first two trials, and 24 per cent for the trial at the high rate of steaming. The loss due to combustible in the ash during these three trials was very low, not exceeding one-half of one per cent.

Where it is intended to burn peat under boilers, it is important to remember that it will be necessary to burn about twice as much peat by weight as ordinary good coal, and that the peat will occupy about 4 times the volume occupied by the coal. To burn it economically, it will be necessary to provide for a large combustion chamber with means for admitting a supply of air over the fire bed, in order to reduce the loss due to incomplete combustion. For peat without an unduly large ash content, the air space between the fire bars should not exceed one-quarter inch. It may also be more convenient to allow for fire doors larger than those ordinarily used for coal fired boilers.

Mechanical methods of firing peat have proved successful in Holland. The method there consists in feeding broken peat to a hopper, from which it is forced by an automatic shovel on to horizontal grate. The difficulties encountered with ash and clinkers when using mechanical stokers for coal are absent with good peat, since the ash all passes very easily through the bars, and no clinker forms.

In Germany, step grates are used successfully for the mechanical firing of peat.

Another method, which as yet has not been fully developed, is to gasify the peat in a producer in front of the boiler and to burn the gas with a secondary supply of air under the boiler itself. It may prove to be too cumbersome for use, but it offers the best solution for complete combustion of the gases.

One of the most interesting and important ways of using peat fuel is in the form of powder. In this form it has served as a fuel for locomotives in Sweden for some years. The annual production of peat powder for the Swedish state railways is now 20,000 tons. The process consists in excavating the peat from the bog by mechanical diggers, drying on the field to 40 per cent moisture content, and conveying to the peat powder factory, where it is crushed, artificially dried to about 13 per cent moisture content, pulverized, and ground.

The powder is burned on the locomotive by feeding it into the fire box, where, in falling, it meets air, and the products of combustion form a small coal fire. The total coal burnt is about 3 per cent of the powder. Tests carried out on a locomotive showed that 1½ pounds of peat powder of a calorific value of 7,700 B. T. U. per lb. generated the same quantity of steam as that generated by 1 pound of coal of a calorific value of 12,600 B. T. U. per pound.

In conclusion, it seems pertinent to say that there is every reason to suppose that the successful inauguration of a peat fuel industry in Canada cannot now long be delayed. Past failures were almost entirely due to lack of appreciation of the fundamental principles involved in its manufacture. In view of the important work accomplished by the Mines Branch, these difficulties should now disappear, and peat should soon find its proper field of use and, to some extent, take the place of imported coal.

The final paper of the afternoon, by Edgar Stansfield, Chief Chemist, Division of Fuels and Fuel Testing, Mines Branch, Department of Mines, Ottawa, Ont., was read by the author on

Low Temperature Carbonization of Fuels

This paper explains briefly the nature and object of carbonization. It outlines the history and development of the carbonization industry in order to define what is meant by low temperature carbonization, and to point out the economic conditions which make its consideration imperative. It also indicates the problems to be solved and the difficulties to be overcome before a low temperature carbonization industry can be successfully established. The paper further considers in order the low temperature carbonization of bituminous coal, lignite and peat, and refers briefly to the similar treatment of oil shales and wood. Especial attention is given to the experiments on lignite now being carried on in the laboratories of the Fuel Testing Station at Ottawa.

A fuel is carbonized in order to change its chemical and physical properties, and thereby convert it into a new fuel or fuels of higher economic value. Certain by-products, which although not fuels are yet of value, are always produced simultaneously but not always recovered.

Carbonization or destructive distillation invariably yields solid, liquid, and gaseous products; the operation is therefore carried out for one or more of three reasons:—(1) to obtain a solid fuel with certain desirable properties, as in the manufacture of coke for blast furnaces; (2) to obtain a gaseous fuel, as in the manufacture of city gas; (3) to obtain liquid products of value as fuels or as chemicals. Thus in some cases the solid residue or coke is the product desired and the liquid and gas must be regarded as by-products, in other cases the gas is the main product. An outstanding example of the liquid distillate being the main product is in the destructive distillation of oil shale, although it is possibly stretching a point to call the original shale a fuel.

That coal yields an inflammable gas when heated in a suitable vessel has been known for over two hundred years; but the foundation of the modern coal gas industry is generally credited to Wm. Murdoch, a Scotchman who in the closing years of the eighteenth century made coal gas and used it to illuminate, first his own house in Redruth, Cornwall; and later (1798) the engine works of Boulton & Watt at Soho near Birmingham. To Stauf, a German contemporary of Murdoch, is due credit for the foundation of the modern coke industry. Charcoal was then in great demand for metallurgical purposes, but wood was becoming scarce, and Stauf obtained a charcoal substitute by roasting coal to form coke, much as charcoal was then made.

Coke is seldom made as the principal product of carbonization, except when required for metallurgical purposes. High temperature carbonization is essential to produce a good metallurgical coke, and temperatures as high as 1200° or 1300°C are maintained in the heating flues of some coke ovens. The manufacture of such coke therefore lies outside the limits of this paper.

In the early days of the gas industry gas was used almost entirely for illuminating, being burned in the old flat burner; gas companies in fact were usually known as gas lighting companies. Iron retorts were used in which to heat the coal, and the temperature was therefore limited to the safe working temperature for iron, about 800°C. With the introduction of brick ovens and fire clay retorts higher temperatures could be obtained, and the gas manager found that he could increase his yield of gas by an increase of temperature. But as the gas yield per ton of coal went up, its candle power went down, and the tar yield went down. This latter point was then of small account so the gas manager was limited in working temperature only by the necessity of providing the statutory candle power of gas, the temperature permissable varying with the richness of the coal employed.

High temperature coking permits a shorter coking period, and gives a higher gas yield and a hard coke with a low content of volatile matter. The primary volatile products of distillation are cracked by the heat; carbon is deposited on the coke, which is thereby strengthened, and also on the walls of the retort; the nature of the tar is changed as well as its quantity diminished; and the gas is increased in volume but decreased in complexity, the richer constituents being broken down into simpler and more stable ones.

Our economic evolution has, however, materially changed our outlook; a fuel such as bituminous coal is no longer merely a source of light, heat, and power, it is the raw material of many industries with innumerable ramifications. Coal tar and the associated ammonia liquor are the source of dyes, drugs, disinfectants, explosives, fertilizers, etc., without which our modern civilization could hardly continue. Motor oils can also be produced by the distillation of tar and the scrubbing of gas, and there is a rapidly increasing demand for such oils. With the fuller realization of the importance of the tar and chemical products of coal, we are naturally led to regard with disfavour the employment of high temperatures whereby those products are broken down and destroyed.

Other economic changes materially affect the carbonization industry. The crying necessity for abolishing the smoke nuisance will lead to the replacement of smoky fuel such as soft coal, by the clean fuels,—coke, oil and gas; and this in time will necessitate producing new types of by-products and discovering new uses for them, in order to increase and spread the demand. The rapid increase in the use of gas for heat and power, and the replacing of the old flat flame burner by the gas mantle (or electric lamp), have led to the almost complete replacement of the candle power standard for gas by the heat standard; which leaves the gas industry free to make further progress. We may be proud to note that Canada was in the front ranks in making this change in the statutory requirements for gas.

Low temperature carbonization introduces many new problems and difficulties; it would be folly to expect any startling revolution in carbonization practice. One serious difficulty may be mentioned here; others will be considered later. A large and complex industry has grown up in the past 60 years or more, with coal tar as its raw material.* This coal tar, however, is a high temperature product, low temperature tar has a quite different composition. We can reasonably hope that it will ultimately prove a more valuable tar, as it contains more of the low boiling constituents and less free carbon and pitch; but satisfactory methods of utilizing it can only be slowly evolved. Progress will be hampered by competition with, and by the conservatism of, a strong, well-established industry.

Bituminous Coal.—Much of what has already been said has special reference to bituminous coals, and need not be repeated.

Table 1, compiled by Vivian B. Lewes, shows the relation between the temperature of carbonization, the volume of gas, and the volume and specific gravity of the tar produced, per ton of 2240 lbs. The figures are of comparative value only, as the yields depend materially on the coal treated and method employed.

*The coal tar dye industry was founded by W. H. Perkin in 1856.

TABLE I

Temperature of Distillation		Volume of Gas	Tar	
°C	°F	Cb. ft.	Gals.	Sp. Gr.
900	1652	11,000	9	1.200
800	1472	10,000	12	1.170
700	1292	9,000	15	1.140
600	1112	7,750	18	1.115
500	932	6,400	21	1.087
400	752	5,000	23	1.060

Table 2, compiled by Lewis T. Wright, shows the gas yielded (per ton of 2240 lbs.), and the composition of the tar produced, by distilling Derbyshire coal at temperatures ranging from 600°C to ordinary retort temperatures. Wright's figures do not show the volume of tar produced, but they do show the decrease in the lower boiling constituents of the tar, and the increase in the pitch, as the temperature of carbonization is increased.

TABLE II

Coal Employed

Carbon	81.92
Hydrogen	5.39
Oxygen	6.88
Nitrogen	1.28
Sulphur	1.97
Ash	2.56

Yield of gas, c. ft. per ton	6,600	7,200	8,900	10,162	11,700
Specific gravity of tar	1.086	1.102	1.140	1.154	1.206
Composition of tar by weight:—					
Ammoniacal liquor	1.20	1.03	1.04	1.04	0.383
Crude naphtha	9.17	9.65	3.73	3.45	0.995
Light oil	10.50	7.46	4.47	2.59	0.567
Creosote oil	26.45	25.83	27.29	27.33	19.440
Anthracene oil	20.32	13.57	18.13	13.77	12.280
Pitch	28.89	36.80	41.80	47.67	64.080

Recent papers by R. Maclaurin [1] and T. F. Winmill [2] are instructive as showing the difficulties to be overcome before low temperature coal tar can be made of commercial value. This tar is paraffinoid in character, high temperature coal tar in benzenoid, and it is the benzene compounds which are used by dye makers. Moreover, Winmill's tar contained unstable, unsaturated compounds, which oxidized and formed objectionable resin bodies on standing.

Low temperature carbonization of soft coal is a particularly important problem in Great Britain, on account of the house heating methods there employed, and serious efforts are being made to establish an industry which shall provide a free burning but smokeless fuel, suitable for use in open grates. Coalite, made by carbonizing soft coal in iron retorts at about 500°C., is a commercial example of such a smokeless fuel. Contracts have been arranged for the erection of plants in different parts of the country for the carbonizing of about 10,000 tons of coal per day. These contracts are entirely in connection with electric undertakings; for the gas fuel derived from low temperature carbonization it is claimed can be sold to such undertakings at a price likely to effect a revolution in the cost of generating electric power. The coalite interests are also now negotiating with gas companies on similar lines, for it is claimed that, by the low temperature carbonization of coal, town gas can be supplied at a very much cheaper rate.

1. Journal Soc. Chem. Indust., June 30, 1917, p. 620.
2. " " " " Aug. 31, 1917, p. 912.

In Canada there is little demand for a fuel for open grates, and the need for an anthracite substitute can be met by an increased production of coke oven, and gas works, coke; that is, by the expansion of established industries. Low temperature coke, which is generally weak and friable, might, however, be made a satisfactory substitute for smokeless steam coal or for anthracite, by means of briquetting; but the double process of carbonization and briquetting will only successfully compete with ordinary coking, when commercial methods of dealing with low temperature tar have been so developed that it commands a good price.

Lignite.—The carbonization of lignite at low temperatures is, on the other hand, a question of great importance for Canada, and one that since early in 1917 we have been systematically investigating in the laboratories of the Fuel Testing Station at Ottawa.

Neither the geographic distribution of our fuels, nor the economic qualities of our different lignites, need be discussed here. It is sufficient to state that Estevan district lignite has been chosen for first consideration on account of both its geographic situation and its low grade.

The coal as mined usually has a calorific value below 7500 B. T. U. per lb., and contains over 30% of water. Thus for every 100 tons of dry coal shipped, handling charges and freight have also to be paid on some 43 tons of water. Moreover, when the coal is burned in a furnace, this water has to be evaporated and sent up the chimney with a consequent great loss of efficiency. If the coal is stored, it gradually loses a large part of its contained moisture, but in so doing the lumps crack and crumble until the product is almost useless for ordinary purposes.

Several methods for increasing the commercial value of this coal might be suggested. For example, it could be dried, powdered, and briquetted. Unfortunately, unlike German brown coal, it is so deficient in inherent binding material that a briquette made without the addition of a binder will not stand storage and handling; whilst briquetting with the addition of a binder is an expensive operation for such low grade material. The briquettes moreover are so high in volatile constituents that they tend to disintegrate as soon as they are heated. Another method would be to carbonize the coal. Lignite, however, does not soften and coalesce when heated, or, in other words, does not coke, so that the product is a friable material bearing somewhat the same relation to the original that charcoal does to wood. This carbonized residue could be used in gas producers, or powdered and used for firing boilers, or, with the addition of a suitable binder, could be briquetted and employed generally as a fuel.

Much work has been done in different parts of the world on the utilization of lignites, and one must conclude from the results obtained that at present the most hopeful treatment for Estevan lignite is low temperature carbonization, possibly with recovery of by-products, and the briquetting of the residue with addtion of a binder.

The work we have so far planned has been divided into three main sections:—

(I) Carbonization.
(II) Briquetting and waterproofing.
(III) Extraction of oils and wax by chemical treatment.

The first of these is well under way, the third has recently been begun, but only a few tentative experiments have so far been made in connection with the second section. The experimental work is being carried out by Mr. Ross E. Gilmore, assisted by Messrs. R. C. Cantelo, T. W. Hardy, and others.

Carbonization.—The carbonization experiments have been subdivided into small scale laboratory tests, large scale laboratory tests, and semi-commercial tests. In the first of these, samples of about a quarter of an ounce were taken; this scale of work allowed of very exact control of the conditions of the experiment and also allowed a large number of experiments to be carried out, under widely varying conditions, within a reasonable time. It was not possible, however, to study the by-products. The results are being used to cut down unnecessary work in the larger tests, they are also valuable as checks on the accuracy of control in all subsequent experiments. In the large scale laboratory experiments samples of about five pounds are treated, and all the products are carefully collected and examined. For the semi-commercial tests a rotary retort is being constructed with a capacity of about fifty pounds. This retort is designed for either intermittent or continuous use; in the latter case it will be possible to coke about thirty pounds of coal an hour, and to recover enough tar oil to make oil engine runs.

In these carbonization tests the results determined include the yield and calorific value of the carbonized residues; the yield, composition, and calorific value of the gas generated; the yield, calorific value, and economic value of the tar oils produced; and the ammonium sulphate yield available. The conditions under which the lignite is carbonized are varied in order to show the influence on the results of: the final temperature to which the charge is heated, the rate of heating, the pressure in the retort, and the atmosphere in the retort.

Lignite from the Shand mine, Sask., has been chosen for first investigation, and a complete series of tests is being made. Later it is proposed to make a number of comparative tests on other lignites. The small scale laboratory tests have been completed, and the results published in a paper read before the Royal Society of Canada in May 1917*; the large scale laboratory tests are progressing very satisfactorily, although the work involved is considerable; the semi-commercial tests will be commenced as soon as the retort and its accessories are completed.

The primary object of the investigation is not to design a commercial plant, but to obtain the accurate data essential for the scientific design and control of such a plant. The commercial significance of the results being obtained can readily be seen in connection with the following points:—

Temperature Control.—Coals are carbonized in retorts operated either intermittently or continuously. Each method has advantages of its own, but the results, especially with regard to tar and gas yields, are often markedly different. As indicated above, both methods are being investigated. The coal near the walls of intermittent retorts is heated rapidly and to a high temperature, the coal in the centre of the charge is heated slowly and to a lesser temperature. In continuous retorts all the charge is heated slowly, although there may be the same temperature difference between the centre and the walls. The effect of the ultimate temperature and of the rate of heating, on the resulting carbonized residue has already been determined; the effect on the by-products is now being demonstrated. When the best temperature conditions are known it will be possible to design a retort in which they can be approximated. Some variations will, however, probably be necessary for economy of construction, upkeep, and operation, and the data obtained will enable the loss due to the changed temperature treatment to be balanced against the gain in economy.

Pressure in Retort.—Experiments have been and are being carried out under low pressure, atmospheric pressure, and high pressure. It is known that by distilling bituminous coal in vacuo, the tar yield is increased and its nature profoundly changed; it is yet to be determined whether there is any increase in the economic value of lignite tar thus obtained, commensurate with the increased cost of the process. The pressure experiments were planned with the idea that the product might require the addition of less binder to form a satisfactory briquette, but this point is yet to be settled. Carbonization under pressure, however, has been shown to give a product of distinctly higher calorific value than normal, the by-products being correspondingly smaller in amount.

Atmosphere in Retort.—Steam distillation of oils, etc., is commonly employed as an economical substitute for vacuum distillation. The effect of the atmosphere in both steam and pressure carbonization tests was found to be quite considerable, and the results indicate that this subject will require careful consideration in any commercial scheme.

Subsidiary Investigations.— (a) The small scale laboratory tests revealed the quite unexpected fact that the carbonized residue is subject to rapid and notable deterioration on exposure to air. The commercial bearing of this is obvious, and the matter is being further investigated. (b) The complete removal of tar from the gaseous products of carbonization is always difficult, but it is especially so in laboratory tests where it is necessary to collect and weigh the tar. The method evolved after many trials is both successful and simple; the application of the principles of this method to large scale work may prove to be desirable.

Briquetting and Waterproofing.—It will not be possible with our present equipment to determine the best mixtures of carbonized lignite and binder, nor will it be practicable to prepare sufficient briquettes to test their wearing qualities during handling, or their behaviour in a furnace. It is hoped, however, to determine the comparative values of different binders, and of different carbonized residues, for briquetting purposes; also to compare the resistance to weathering of the briquettes produced.

Briquettes made with some binders such as coal tar pitch are waterproofed by the binder, briquettes made with other binders such as sulphite pitch require to be waterproofed by subsequent treatment with oil or bitumen, or by a quick coking roast. It is proposed to make a careful study of these methods of waterproofing.

Extraction of Oils and Wax by Chemical Treatment.—Certain German brown coals are commercially treated with solvents in order to extract valuable waxes and oils. It is well known that Canadian lignites are markedly inferior to those German coals in their bitumen content, a fact which has been confirmed by the extraction tests so far carried out; nevertheless it seems important to carefully study our lignites with a view to the possibility of obtaining larger yields, or better qualities, of motor oils by extraction methods than can be obtained by carbonization.

It is also expected that these extraction tests will supply a quick method for the comparative evaluation of all available lignites.

*Carbonization of Canadian Lignites, Edgar Stansfield & Ross E. Gilmore.

This work is being carried on simultaneously with the work on carbonization.

The following diagrams contain curves prepared by Mr. Gilmore from the results of the small scale experiments. Diagram I shows the loss of weight in carbonizing, also the calorific value of the carbonized residue, plotted against the temperature of carbonization. Diagram II shows the relation between the calorific value and the yield of the carbonized residue. Several curves are given in each diagram, these representing different methods of carbonization. It can be seen that the calorific value of the residue increases rapidly with the increase of temperature to about 575°C. after which it decreases. Low temperature carbonization is therefore essential for such lignites. The average analysis of the coal used for these tests was: Moisture, 31.75%; ash, 5.20%; volatile matter, 28.05%; and fixed carbon, 35.00%. Its gross calorific value was 7733 B. T. U. per lb.

Tables 3, 4, 5 and 6 illustrate the nature of the results obtained in the large scale laboratory tests now in progress. In the particular test here reported the charge was slowly heated up to 650°C. The results of a similar test on peat are given for comparison.

Table III

Low Temperature Carbonization of Lignite and Peat Slow Heating up to 650°C.

Analysis of Fuels

		Shand Lignite as coked	*Shand Lignite* dry	*Alfred Peat* as coked	*Alfred Peat* dry
Water	%	30.9	. .	11.4	.
Ash	%	8.7	12.6	4.8	5.4
Carbon	%	43.4	62.8	49.1	55.4
Hydrogen	%	6.1	3.8	5.9	5.2
Oxygen	%	40.6	19.2	38.8	32.3
Nitrogen	%	0.8	1.1	1.3	1.5
Sulphur	%	0.4	0.5	0.1	0.2
Calorific value B. T. U. gross		7,270	10,520	8,430	9,520
" net		6,690	10,160	7,880	9,005
Soluble in benzene	%		0.8	.	4.9
" in carbon disulphide	%	. .	0.5	. .	3.7

Table IV

Weight Balance Sheet—Results on Dry Fuel

Coke yield	Lignite	62.9%	Peat	41.4%
Tar yield		3.5		12.0
Gas yield		18.9		26.8
Water yield		14.5		19.4
Unaccounted for		0.2		0.4

Thermal Balance Sheet

Heat units in products, as percentages of heat units in charge.

Coke	Lignite	72.9%	Peat	54.7%
Tar		6.0		20.7
Gas		11.8		10.8
Loss (formation of water, etc).		9.3		13.8

Commercial Products

Coke—pounds per ton dry	Lignite	1,260	Peat	830
Coke—calorific value, B. T. U. per lb.		12,200		12,800
Tar—imperial gallons per ton dry		7		24
Gas—cubic feet per ton dry		6,100		6,600
Gas—calorific value, B. T. U. gross		407		314
Ammonium sulphate—pounds per ton dry		15		25

Table V

Character of Tar Oils

Density of heavy oils	Lignite	. . . . .	Peat	1.029
Density of light oils		. . . . .		0.939
Density of total tar oils		0.982		1.005
Calorific value—B. T. U. per lb.		16,850		16,150

Distillation yields as percentages by wieght of tar:—

—170°C.	Lignite	9.1%	Peat	1.7%
170°—200°C		0.0		6.4
200°—270°C		24.4		25.9
270°—310°C		18.0		25.2
Residue		37.7		32.5
Water		8.4		3.3
Loss		2.4		5.0

Table VI

Analysis of Gas

The gas in each case was collected in two fractions a & b.

		Lignite a	Lignite b	Lignite average	Peat a	Peat b	Peat average
Volume collected cb. ft.		5.0	4.1		5.2	4.2	
Carbon dioxide	%	42.3	14.7	29.8	62.0	21.0	43.7
Ethylene etc.	%	2.2	0.6	1.5	3.0	1.3	2.2
Oxygen	%	2.4	1.2	1.9	2.3	0.9	1.7
Carbon monoxide	%	9.2	13.9	11.3	12.1	12.7	12.4
Methane	%	25.9	28.9	27.2	12.4	24.9	18.0
Hydrogen	%	12.4	37.2	23.6	1.2	38.2	17.7
Nitrogen	%	5.6	3.5	4.7	7.0	1.0	4.3
Density	%	0.98	0.60	0.81	1.25	0.65	0.98
Calorific value B. T. U. per cb. ft.	gross	363	463	407	215	434	314
	net	328	414	366	200	384	282

Peat.—With peat, as with lignite, carbonization converts a low grade fuel into one with high calorific value and low volatile content. Peat, however, unlike lignite, does not disintegrate when heated, and the carbonized residue, generally called peat coke, is distinctly stronger and harder than wood charcoal and may be used without briquetting. The increased price of wood has resulted in experiments to ascertain whether peat could be used as a source of wood alcohol, acetate of lime, etc.; the yields were low but the substitution is not impossible.

It must be clearly understood, however, that carbonization could only be supplementary to, not a substitute for, air drying, as the cost of distilling wet peat would be prohibitive.

Oil Shale.—Oil shale is not, as its name suggests, shale impregnated with oil. It contains little or no free oil; but does contain bituminous matter that yields oil when subjected to destructive distillation. Low temperatures are employed to avoid the wasteful breaking down of the oil vapour into permanent gases.

Wood.—Wood was formerly carbonized for the sake of the charcoal; at present wood alcohol, turpentine, acetic acid, and wood tar oils are products more in demand than the charcoal. It is customary when distilling wood to drive off the water as rapidly as possible, and then to maintain a temperature in the retort of slightly below 300°C., as long as distillation continues. The process is then completed by raising the charge to about 500°C.

Conclusion.—In conclusion therefore it may be stated that the low temperature carbonization of bituminous coal appears likely to assume immediate importance in England, and possibly elsewhere; but in Canada the need for such a development is far less. The low temperature carbonization of lignite, peat, oil shale, and wood, however, may soon play a considerable part in the economic development of this country.

At the conclusion of Mr. Stansfield's paper the President announced that through the kindness of the President, Mr. Rorke, the courtesies of the Engineers' Club had been extended to visiting members of the Society.

Referring to the papers presented, after remarking on their general interest, Mr. Vaughan said:

"We have had, gentlemen, a most interesting set of papers. Mr. Haanel has given us a statement about fuels in Canada, their distribution and the necessity for their development; Mr. Neal has presented the railway standpoint, and Mr. Dick most valuable suggestions as to what should be done in connection with the fuel situation. Mr. Blizard's paper on peat, I am sure, has explained to us what has been done in the utilization of peat, and Mr. Stansfield's paper has discussed low temperature carbonization. All these papers carry for us in Canada a great measure of hope. The present may be troublesome; we may be experiencing a great shortage of coal, but it certainly is most encouraging to know that the country as a whole is well provided with fuel, and it is not a question of our looking forward to a shortage in the future but a question of our having to proceed to develop it. One thing that we are not touching on in this meeting—and perhaps we should as engineers have paid rather more attention to it—is the possible economies in the use of coal. Mr. Neal touched upon it in his railway paper. I certainly believe from my railroad experience with railways on this continent, the railroads of Canada have paid more attention to fuel economy and have obtained better success in it than any other railways on the continent. I do not believe that we could say that they are the most economical in the world, because economy in fuel is not only a question of the cost of fuel but it is a question of the cost of labor. It is a very old saying that you cannot put anything on a locomotive that does not cost money to maintain, and foreign railroads have been with their cheaper labour in a better position to use appliances that lead to economy in coal than Canadian railroads where the waste in coal was not as important as the increased cost of labor involved. However, we may say that on this side of the water the Canadian railways were the pioneers in the use of superheat. Years before it was taken up in the States to any great extent locomotives on this side of the line were extensively equipped, and I do not believe it will be any exaggeration today to say that the millions of tons of coal used by railroads in the past year would have been increased at least 10% if the economies or superheat had not been obtained. The pulverized fuel question has not gone ahead in Canada, and I really feel it should have been taken up more actively. It has a most promising field and if, as we are led to expect, it can lead to practically sparkless operation, it would be a method of great advantage in locomotive use where the objections to sparks is as vital as it is in our western country.

I think, however, that we must congratulate ourselves on the whole on the series of papers we have had. I do not think we could have looked for a more comprehensive series of papers on the present and general fuel situation of Canada. These series of papers present or suggest definite lines of activity and definite lines of development that should be followed. They are not simply papers saying that a situation exists and something ought to be done, but we have here a series of papers that say that certain definite things should be done and Mr. Dick specially opens up a heavenly vista in the way of fuel that really is worth coming from Montreal to hear."

Saving Coal

Mr. L. M. Arkley, M.Can.Soc.C.E., Assistant Professor of Mechanical Engineering, University of Toronto, opened the discussion on the papers presented and proceeded to demonstrate how, approximately, a million tons of coal could be saved each year in Canada. He presented a sketch of a water tube boiler, which showed what happens when coal is burnt, to demonstrate how this could be accomplished. It requires a minimum of 11½ lbs. of air to burn completely a pound of carbon to carbon-dioxide. This means that we must have a definite quantity of gas going out for every pound of carbon burned. Under ordinary conditions the temperature of the furnace will be 2500 degrees and the flue gases 450 degrees. The main loss in a steam boiler is the loss due to the heat going up the chimney. There is also a certain loss due to the burning of coal to carbon monoxide instead of carbon-dioxide. The heat loss up the chimney is made up of the number of pounds of gas multiplied by the rising temperature multiplied by the specific heat of the gas which is constant. We have a definite method of finding out how many pounds of gas per ton of coal is going up the chimney. Where conditions are good we might get 15% of carbon-dioxide and 6% of oxygen and a fair result would be 12% of CO_2 and 9% of oxygen which is something that almost any boiler operator might hope to obtain if he operated the boiler properly. For ideal operations we want low flue gas temperature and we want high CO_2. The reason for faulty operation is due to scale and soot on the tubes and the remedy is to keep the heating surface clean both inside and out. Another cause of faulty operation is holes in the baffle plate. The main cause of the low CO_2 is due to leaks in the setting, that is through the brick-work and the second by having the fire too thin. All brick-work should be pointed with some substance that will stop the pores and keep the air from getting in and a thick fire should be carried with reduced draft. It is a simple method to analyse the flue gases. By giving consideration to these points a saving of at least ten per cent can be effected in the fuel consumed in the operation of boilers. With the price of coal going up all the time and its increasing scarcity it would be well if the methods of fuel economy in boiler operation were given the most serious consideration. To effect this we should educate the men responsible for firing boilers.

Mr. James White, member of Council, M.Can.Soc.C.E., Deputy Head, Commission of Conservation, Ottawa, took up the discussion, referring to the papers by Mr. Haanel and Mr. Dick in connection with the regulations respecting the operation of locomotives, during the dry seasons in the prairie provinces particularly. When these regulations were put into effect it was predicted by practically every one that the railway companies would not observe them. Some six years have gone by since these regulations were made effective and it is found that the railway companies are eminently satisfied with the result obtained, so that, in that time, from being one of the greatest offenders in setting fire to the forests of Canada they have become one of the least. Continuing, Mr. White said: "In conversation the other day with Mr. Magrath he brought forth a suggestion which is eminently practical in connection with lignite, which was that lignite should be mined in the summer, shipped to the consumer who could simply dig holes in the ground and cover it with several feet of earth, which would remove all danger of its disintegration. In connection with the proud preeminence Canada occupies, in respect to super-heating in locomotives the President omitted to say that that position is largely due to Mr. Vaughan, when he was Chief Mechanical Engineer, of the Canadian Pacific Railway."

President of Mining Institute

Mr. D. B. Dowling, President of the Canadian Mining Institute, on being called upon stated that nearly all phases of the fuel situation had been discussed but that a very important one, viz., natural gas, had not been mentioned. In the Western prairie provinces natural gas was an important item of fuel affecting a considerable saving. It is found in the gas wells that as the initial gas decreases or the pressure decreases there are signs of other oils, volatile oils, being present in the gas. There is a large area in the Northern part of Alberta which is being tested and in which the Geological Survey is helping oil and gas companies in their research. To effect the greatest economy from the gas wells is a problem for the Chemist and one which is worthy of serious consideration.

Discussion on Peat

Mr. H. Anrep, Peat Expert, Department of Mines, in discussing Mr. Blizard's paper, mentioned that he had been responsible for investigations not only in Canada but in Russia, Sweden, England, Ireland and Scotland.

Mr. Blizard referred to the fact that, up to the present, approximately 300 square miles of peat bogs have been investigated by the Mines Branch, "and since I am responsible for the investigations—not only of the 300 square miles of bogs in Canada, but of numerous bogs in Russia, Sweden, England, Scotland and Ireland, I thought some additional remarks of mine on the investigation of peat bogs might possibly be of some interest.

Peat is classified according to various degrees of humification, which can be distinctly noticed in some of the European peat bogs, and occasionally here in Canada. Looking at the vertical section of such a peat bog, we would find that the bottom stratum contains very well humified peat fuel, which feels like a slippery, greasy, gelatinous substance, of a practically black color. This peat is very plastic, close in texture, and has very high cohesive properties. If we try to squeeze water out of it by hand, we shall find that the peat squeezes through the fingers, without losing a drop of water. The thickness of such a layer varies in depth from 2 to 7 feet. Above this, the various upper layers are less humified, and lighter in color, until the surface growth is reached, which is usually well preserved, and practically not at all humified. This upper layer varies from 1–2 feet on the so-called peat fuel bogs. There are also bogs which have a considerable depth, as great as 30 feet, which are practically not at all humified. Generally, such bogs consist entirely of mosses, and are called peat litter bogs, but fuel bogs have usually the upper layers composed of mosses, and the layers towards the bottoms are intermixed with mosses, or formed entirely of other peat-forming plants. To give a detailed description as to why such changes in vegetable formation take place would be too complex and take a great deal of time.

The average Canadian bogs are more uniformly humified than those in Europe, and the changes of humification through the various layers are not so rapid, which makes it more difficult to determine the quality. The determination of the quality of the peat is performed in the following manner:

A sampling drill is used, which takes the samples out of various depths of bog, say, for instance, the first sample from a layer of 3 feet, the second sample from a layer of 7 feet, and so on, until the bottom of the bog is reached. Each sample of the various depths is taken and inspected on removal, particular attention being given to the vegetation composing it. Experience shows that as the drilling proceeds towards the bottom layers, the calorific value of the peat increases. For this reason, all the samples from the various layers are thoroughly mixed, and formed into a general sample, which is analysed.

The peat litter samples, for analysis, are taken from each layer separately, and samples from each layer are intermixed only when they are of a uniform texture and color.

Those bogs which are not sufficiently humified for the manufacture of peat fuel, or too highly humified for the manufacture of peat litter, have, up to the last 7 or 8 years, been considered waste, but such bogs, when analysed, showed that they were of high calorific value, and could be utilized for the manufacture of peat powder. For instance, in Sweden, on the State Railway between Stockholm and Ringby, the only motive power is derived from peat powder. During this war, over a million dollars have been invested in the erection of peat powder plants in that country.

I hope I am not taking up too much of your valuable time, but I would like to say a few words on the manufacture of peat.

During my 15 years' experience in connection with peat, and especially during the earlier part of my career, when I erected peat plants and manufactured peat in Sweden, Ireland, and Canada, I have learned considerable about the curing of the peat on the field; that is, after the peat has passed the mechanical stages of handling and is left on the field to be dried by the sun and air down to 35 to 25% moisture.

When the macerated peat, containing 87 or 90% moisture, is spread on the field, it is left there to dry until it can stand handling. This time depends very much on the weather conditions. Then it is turned by hand, and this is usually done by children, who receive so much per 1,000 bricks. After the peat has been turned, it is important to see that it is not left too long on the field, but is piled as soon as possible, as too long a contact of the dry surface of the peat block with the wet surface of the bog seems to cause the peat to deteriorate. When peat is piled or cubed, as we say, care must be taken that it is not

exposed too long to the sun, because if it is left on the field to dry to less than 20% moisture, it is apt to crack, and the blocks become very brittle, which would entail a great percentage of waste. Therefore, the piles, or cubes, ought to be removed when the peat block contains 25% moisture.

In the beginning of the working season, I sold the peat at Alfred directly from the field where it was piled to the farmer, as I, of course, knew approximately how much each row contained, and divided the rows into ton lots. This saves labour and a higher price can be obtained for peat per ton.

It is clear from these few considerations that there are many necessary operations in the manufacture of peat which can be learned only by experience.

Lecture on Quebec Bridge

In the evening, Mr. Geo. F. Porter, Superintendent of Construction, of the St. Lawrence Bridge Company, gave an illustrated lecture on the erection of the superstructure of the Quebec Bridge, which will be published in full in this year's transactions.

Wednesday, March 27th.

In calling the meeting to order at nine o'clock, President Vaughan stated that inasmuch as we had discussed on a previous day a number of papers dealing with the general fuel situation in Canada, not from the immediate viewpoint but having in view what was required in order that the country might be self-supporting as to its fuel supply in the future, this morning we would have one or two papers directed to the immediate needs of the situation, in other words, the consideration of the fuel shortage that has been created by the war. The President then called upon Mr. Albert Grigg, Deputy Minister, Department of Lands and Forests, Ontario, who had kindly consented to give an address on

Ontario's Efforts to Relieve the Fuel Situation

First of all, do not labor under any misapprehension as far as I am concerned—I am not a fuel expert. I make no profession to anything along that line. We are just trying to work out a practical solution of what we believe to be the immediate problem. Perhaps it would not be necessary for me to try to prove to you or convince you that there is a problem in regard to fuel in the Province of Ontario at the present time. While I have not made any exhaustive study of that particular subject, yet from what I have been able to gather from men who have, and from the general concensus of opinion that is expressed throughout this Province and throughout this Dominion I take it for granted that you are well convinced, the men who form this meeting, that there is a problem to be solved in our Province particularly at this time.

To my mind the real problem is to convince the people that there is a problem. That seems to me to be the first work that we have in hand—an educational propaganda, in order that the people as a whole may realize and come to know that there really is a problem with regard to shortage of fuel in this country. I am convinced personally that that has not yet found its way thoroughly into the minds of the great masses of the people. I may possibly be wrong in that but that is my own personal conviction.

I noticed in this morning's paper—I am not here to criticize, of course, the press—but I noticed in big black headlines this morning that the Fuel situation was not as black or not so black, something of that kind. Had you gone to the homes of some of the people of this City the last few months you would have found it was very black so far as actual fuel was concerned in some places. Now, I believe that we should get away from that idea. I believe that the greatest thing, as I have already said, is to convince the people that we have a problem. You know, people are slow to learn. We get in the habit of having certain things. We do not know from whence they come; we have been in the habit of ringing the telephone and saying, "Send me up a ton or two of coal and my cheque will go forward," and we have been in the habit of getting that, and it is a very difficult thing to get the people away from the thought that that same thing will not continue from year to year. They have always had a certain thing and they always will have it. We are approaching this question at a time of year when it is even more difficult. It is a pretty difficult thing to convince people that there is a fuel shortage amidst the heat of our Canadian summer. Let me emphasize, in my mind at least, this thought: that our greatest problem, our first problem is to get it thoroughly into the minds of the people that there is a real fuel shortage in this country. If I were going to give you a word in connection with this it would be "Preparedness." That is a word that has been much used in these days—"Preparedness." It has been said that Great Britain entered the present great world struggle without being prepared, and when the future historian writes the history of this great struggle that will be her vindication. Already men are beginning to talk about that. The unpreparedness of Great Britain for this great struggle will be her vindication. So that we at this time I believe, in connection with this particular problem, should be prepared, and the first thing, again let me say, is that we get it fully and thoroughly into one's mind that there is a real shortage. The fact that you men are here—intelligent, scientific, professional men, devoting a great deal of the time of your meeting to this particular subject, is evidence of itself that there is a real crisis in regard to the problem of our future supply. And one of the rather peculiar things is that when this crisis is over, when we have solved this problem as we hope to be able to solve it by the united efforts of our people, the cynic and critic will stand back and say "I told you so. I got all the fuel I wanted." That is one of the things you have got to be prepared to meet.

In the Province of Ontario, generally speaking, we are in a unique position, as I understand it, and our problem is perhaps a little more acute than the eastern or western provinces. Speaking in a general way, I suppose if it came down to a real test and to a real necessity our western provinces could largely take care of their own fuel supply from the coal fields they have in Alberta—may be not entirely; but they might be able to meet that in a fair way from the coal stand-point. The eastern provinces might also be able to meet a fair demand on their resources for that particular purpose. The Province of Ontario, however, lying in the middle, as I understand it, has a little different problem with which to contend than these other provinces. The transportation question, of course, is one that has been already dealt with and it is not necessary for me to bring it to your attention, but the great thing that faces us is that we have been getting our supply from the United States. With the increased demand upon their resources for their own manufacturing purposes, you all understand, of course, that we cannot look forward for that great supply in the

future that we have had in the past. The result of that is that we must in the Province of Ontario look for some methods of substitution for these vast supplies that have been at our doors so easily obtainable in the years that have passed.

There are two great sources of substitution in the Province of Ontario; there may be more but there are two at least. A great deal of attention is being given to the peat bogs of the Province at the present time. I am not going into that to any exhaustive degree but those who have studied that tell me this: that one of the great difficulties up-to-date in dealing with that is the excessive cost of production and it is hoped to be able in the near future to meet to some extent that condition. My figures may be wrong but my information is that to produce peat today that is satisfactory for heating purposes, about 25% of the cost is concerned by labor alone.

At the Inter-Provincial Conference of the Prime Ministers and representatives of the various provinces they made recommendation, I am told, that each Province should appoint a Fuel Controller; a Fuel Controller whose business it would be to deal altogether with provincial matters. I am informed that the Province of Ontario is proceeding along that line, and, if not already done a Fuel Controller will be appointed in the near future. In addition to the Provincial Fuel Controller I believe it was also recommended that cities like Toronto, Hamilton, Ottawa, etc., would also have local fuel controllers, they to co-operate with the Provincial, and they together with the Dominion, work out in co-ordination and co-operation some adequate solution of this problem.

I am told that steps are already under way by the Ontario Government to investigate this peat situation, and my information is to the effect that within the very near future we hope to obtain some very reasonable results from that work and from that investigation.

The second source of supply or perhaps that with which we, over in the Parliament Buildings, are immediately concerned because it is at least immediately available, is the question of our wood supply. Coming as I do from Northern Ontario and not from a very large manufacturing centre, it seems almost impossible for me to conceive that in the homes of the great mass of the people, at least of Ontario, there could be any shortage of fuel in this Province. You know we have boasted of the vast forest reserve in the province. And those of you who are familiar with that will particularly realize that having lived there for a number of years and realizing what vast resources are there at our command, it seems almost impossible that, if properly worked out, there should be any real suffering on the part of the people so far as the question of heat is concerned.

What we are trying to do in the Province of Ontario, briefly is this: We have sent out to all municipalities throughout the Province this word: Wherever they can find timber wood suitable for fuel purposes on land owned by the Crown we are prepared to give them the permits free of charge to cut whatever supply of wood they may need. We had numerous applications from private individuals as soon as that became more or less generally known; private individuals all over the Province began to make applications for permits. Up-to-date we have discouraged that, for this reason: We believe first and foremost that to encourage the private individual to go into the production of fuel from Crown lands would tend largely to place the fuel supply that he might be able to obtain in his own hands and place it on the market at his own prices. It would undoubtedly entail a tremendous amount of detail work in the Department in trying to keep track of the various operations along that line. But, based on this fact, that we believe the municipality is primarily responsible for the fuel supply of their own people, that they are in a better position to work out the details and control prices than private individuals could do, we have said to the municipalities: The lands of the Province at your door anywhere in this Province, are open to you as municipalities; permits will be given to you and they are to be cut, under proper supervision, of course, according to whatever source of fuel you may happen to work out. Already cities like Toronto, and some of the eastern cities like Ottawa, North Bay, Sudbury, and a great number of the other towns and cities throughout the province have availed themselves of this opportunity, and permits are being issued almost daily to the various municipalities throughout the province. And we think in this way, for domestic purposes at least, we will be able to supply a fair amount of the demand that will be made upon them. Now, it is one thing to figure a thing—it has been said that it is much easier to be a preacher than a doctor, because they say it is easier to preach than practice. The Ontario Government realizing that, have immediately taken steps and today an organization is under way whereby we hope to be able to take from the large areas of the timber lands of Algonquin Park alone, (where there is almost an illimitable supply of wood for fuel purposes) sufficient to keep all the public institutions in this province in fuel during the coming year. We may not be able, of course, to meet every little demand along that line, but in a general way the Government believe that they should set an example to the people of the province and to the municipalities, and that they should not ask the municipalities to do something which they are not willing to do themselves, and they are willing to be pioneers in this regard. We hope that during the present summer sufficient fuel will be cut from the timber resources of Algonquin Park to supply the different institutions of this province. Now, that means, of course, that when you get these sources of supply you have not yet solved your problem. The heat and power apparatus installations of the province, even in the homes, are largely adapted—particularly in the great centres of population and these large institutions—for the consumption of coal, and that means the readjustment of the heating machinery which we have in these institutions and which you have throughout the homes of these cities. That will be one of the works that will be necessary, one of the problems that your fuel controllers in your cities and our provincial fuel controller will have to contend with. It will be their business to look into these problems and make such changes as is deemed necessary in order that the present systems may be so readjusted that they will be able to use economically and profitably the wood which will be supplied from the sources already mentioned. $100,000, as you know, has been set aside for this purposes to be used by the provincial administration. This money will be used along the lines already indicated, making investigations, searching out for information, making and providing for supplies of wood and working out a multitude of details for things which will necessarily arise from time to time. You will understand, of course, that in working out problems of this kind you can only meet the difficulties as you approach them, and you only find them as you attempt to do something.

We believe that it will be first of all necessary to carry on a great educational campaign. To that end we expect to circularize the entire province. We expect to advertise

extensively in the daily press, let the people know, and have them prepared for the fact that it is necessary for them to take an interest in this matter in order that the situation may be properly met. In short, for I have no desire to take up your time this morning, the Ontario Government will try to be on the job in this connection and they will try to do and act along whatever lines may present themselves and may be advisable from time to time as circumstances will warrant.

Let me just say in conclusion, that perhaps one of the great lessons of the war that has been taught us is the question of self reliance. We have boasted of our vast resources in the Dominion of Canada; we have boasted of being a great Dominion, and yet I heard a couple of the gentlemen here discussing it—and it was along the line I had in my mind this morning—that had we been suddenly thrown on our vast resources, had our supplies from the United States and other countries in fuel been suddenly cut off, we Canadians, who had boasted of these great natural resources, would be largely helpless. And it is one of the things that we are trying to solve. It is an evidence of the activity of the mind of the Committee which have met this morning that we in this great Dominion should develop our own resources, we should stand upon our own feet, we should be more self-reliant than we have ever been in the past. And I am sure when we give this subject of fuel the consideration that it deserves; that when we have fully investigated all the possibilities that are latent in our own Province and in our own Dominion, the result will be wonderfully beneficial to us in the years that are to come. (Applause.)

Following Mr. Grigg's address, a paper was read on "Wood as an Emergency Fuel," by Mr. E. J. Zavitz, Provincial Forester, Ontario.

Wood as an Emergency Fuel

With the exception of a few out-lying agricultural districts, southern Ontario has in the past years depended upon anthracite coal or natural gas as a winter fuel. The wood lands of southern Ontario could not replace coal for any great length of time as a source of fuel. Many countries have today only about 5% of wood land of an inferior quality. In a region where the virgin forest produced 40 to 70 cords of wood per acre the present wood lands would only yield from 10 to 20 cords per acre.

However, during the present emergency, an educational campaign should be instituted in the rural communities, warning them of the necessity for securing wood as a fuel. I might say instead of should be instituted, should have been instituted, because I am quite satisfied that so far as next winter fuel situation is concerned, any wood that can be procured before next autumn will not affect the situation very much. I say that a campaign should be instituted in the rural communities warning them of the necessity for securing wood as a fuel for the coming winter.

Mr. Grigg has referred to the question. I believe there are rural districts, however, where it would be quite difficult to secure wood locally. I know a great many farmers in such counties as Brant and Oxford who have not a cord of wood on their farms and are entirely dependent on coal. Their heating plants are the same as ours in the city and they would be in the same situation as we would in regard to lack of coal. And there is a great deal of the southern part of Ontario under this condition. The largest remaining areas of hardwood left in Ontario are those lying between Georgian Bay and the Ottawa River, sometimes, spoken of as the Huron-Ottawa region. When we get north of this region the more valuable hardwoods begin to run out. and as we go over the height of land it is somewhat difficult to get valuable fuels.

If the larger towns and cities of southern Ontario had to secure wood in large quantities to supplement the shortage of coal, this is the only available supply in this region. I presume the simplest method of securing wood from the Huron-Ottawa district would be to contract with local firms or settlers for the delivery of wood at the right of way, owing to the shortage of labor and the difficulty of putting in organized camps. I understand the chief difficulty would be in securing cars for the moving of any large quantities.

Fuel wood from this region would cost the consumer in Toronto from $12 to $15 per cord. I believe the quotation yesterday was about $14 per cord, and you readily see when you understand the heat value of wood that this is rather an expensive form of fuel and only to be thought of in large cities in emergency time.

The standard cord of wood contains 128 cubic feet, and I understand this has been made the legal cord by a Federal order-in-council. The cord is usually a stack of wood cut into four foot lengths and piles 4 feet high and 8 feet long. While a stack contains 128 cubic feet, the actual wood contents will vary depending on the shape and straightness of the individual sticks. A cord of wood will contain anywhere from 90 to 91 cubic feet of solid contents; the ordinary cord wood stacks are supposed to contain 70 to 80 solid cubic feet of wood. Local standards are sometimes used where a stack is 4 feet high and 8 feet long but the length of the stick only 16 inches or 2 feet. In cities people frequently are confused and, in fact, swindled in the difficulty of knowing the standard cord.

In general, the fuel value of wood varies directly with its weight. A cord of dry hickory or white oak will weigh about 4,000 lbs. and is equal in fuel value to one ton of coal. A cord of pine or spruce weigh about 2,000 lbs. and is equal to about one-half a ton of coal. Our common trees have the following weights and therefore relative fuel values: Hickory and white oak about 4,000 pounds to the cord. Now, with the exception of a few local districts along Lake Erie, we have no hickory or white oak available for fuel wood. Sugar maple, beech and red oak weigh about 3,000 pounds to the cord. Yellow birch, white birch, soft maple about 2,000 pounds to the cord. Elm, tamarac, poplar, spruce and pine about 3,000 pounds to the cord.

In addition to the weight of wood, another fuel value factor must be considered. The resinous or coniferous woods such as pine burn very rapidly and are not suited for purposes where a continuous fire is desired, but give out a quick hot flame which soon dies out. For this reason they are favored as a summer wood.

It is also important that the question of drying be emphasized in this matter. Green wood contains about 25% of water and in burning there is considerable loss of heat caused in evaporating the water. For this reason I say that for next winter's fuel wood that has not been cut by this time or very shortly will lack a great deal in fuel value."

Discussion on Wood Fuel

In opening the discussion Mr. James White pointed out that a year ago last February the Commission of Conservation had issued a warning respecting the impending fuel shortage and that during the months of May, June and July, of last year, the imports of anthracite coal into Canada were increased about ten per cent above the normal; further, at the request of the Fuel Controller, they had taken charge of a campaign for an increased supply of wood fuel for Canada in the future. He contended that more wood should have been cut during the last winter by the municipalities since the strain next winter will be as great or greater than last winter. Ottawa had laid in some 13,000 cords of wood and Winnipeg some 50,000 cords. It was absolutely necessary to provide extra fuel for the coming winter and no other fuel than wood is available in large quantities. The wood could be burned in the fall and the spring reducing the necessity for burning as much coal as formerly. The appointment of provincial fuel controllers was an immediate necessity.

Mr. Grigg mentioned in respect of burning wood as a fuel in homes, that he had a large ten roomed house in Northern Ontario in which was installed a hot-water stove and that he would prefer to burn hard wood to coal at any season of the year. By adapting the present coal furnaces to the burning of wood the furnace will undoubtedly do as good work in the winter time with wood as with coal.

Mr. G. Stead, Chatham, N.B., in adding to the discussion, remarked that he came from a well wooded country in New Brunswick and that during last year he had burned wood entirely in his home, consisting of about 50 loads of mill waste, costing $50.00. There would be danger in Canada if we were obliged to use too much of our wood supply for fuel inasmuch as a great many of our industries are dependent on the growing timber. Mr. W. K. Greenwood stated that there was in Northern Ontario a large amount of fallen timber lying on the ground which was allowed to rot. He thought that instead of allowing the farmer to cut growing timber this wood should be used. Mr. Hayward said, apropos of adapting a coal furnace for wood use, that he had found an extremely simple way of reducing draft by putting in three or four little key dampers.

Mr. W. A. McLean, Deputy Minister of Highways, Ontario, pointed out, in connection with the utilization of our natural resources, that the one source of supply which would reproduce itself was timber and therefore he thought the Forestry Department should turn its attention to a far sighted policy of reforestration which would help to make us independent of foreign supplies of fuel. Mr. Clyde Leavitt strongly endorsed the point made by Mr. McLean, stating that the Provincial Government should regulate the method of cutting so that the forest is not destroyed as a forest, so that it would yield a harvest from year to year. He thought that the Government could make use of labor from the penal institutions for the purpose of securing a wood supply. The farmers too could cut more wood in the winter without affecting the labor problem on the farm which a campaign for cutting wood in the summer would do.

Mr. Grigg emphasized a point made in his address that it devolved primarily upon the municipalities themselves to become virtually interested in their own welfare. A municipality could secure labor where the Government could not. The labor problem at the present moment increased the difficulties materially. Mr. Zavitz pointed out that the newspapers had published a great deal about utilizing burnt timber for fuel. The cost of getting out such timber was prohibitive. He had found also that birch and maple, after lying on the ground for two seasons, was practically worthless as fuel. Mr. John Murphy illustrated the situation by drawing a curve showing the peak load of a transmission system. He reminded those present that most of the trouble was in taking care of the peak or period of maximum consumption. An educational campaign was necessary to teach people to use other kinds of fuel sparingly at other seasons of the year and conserve their coal for the peak period.

A Western Viewpoint

Mr. W. P. Brereton, of Winnipeg, compared the fuel situation in Ontario with that in Winnipeg, which was near the dividing point between the American supply and the Western Canada supply of coal. Last year Winnipeg had fared well in regard to coal supplies, having received a large amount of lignite lump from the West which after some difficulty at first gave final satisfaction. The situation this year was somewhat uncertain. The Manitoba Branch, recognizing the difficulty that might be experienced next winter, studied the situation and decided that an educational campaign was necessary to induce people to buy coal in the summer which would naturally be Western Canada coal. This matter was taken up with the prominent business bodies and was referred to the Fuel Controller. Winnipeg may be in a very serious situation regarding fuel for next winter. For the future the main problem seems to be the utilization of the lignite slack from the Western mines which at present is entirely wasted. The problem would be solved in the future by briquetting the lignite slack, possibly supplemented by the use of gas producers and the use of powdered fuel. He requested further information regarding these.

Mr. Haanel mentioned that exhaustive tests on the utilization for various purposes of the lignites of Saskatchewan and Alberta were being carried on. The great trouble with lignites was due to the fact that while some of them were apt to slack after being mined others did so when subjected to the heat in the stove, which choked the draft. For this reason he recommended that lignites should be prepared artificially by process of carbonization, to prevent slacking. Storage in pits would not prevent it. Commercial tests were being made on coal from various mines as to their suitability for gas producers and it was found that some of them were entirely suitable for the production of gas in gas producers and that such gas might be piped from a central heating plant. The question of cost had to be considered but it could be done. To supply the whole country in Western Canada, however, could be accomplished only by carbonization at low temperatures and briquetting. The whole problem in regard to wood, coal, lignites, and peats seemed to be that too little attention had been given to the development and exploitation of fuels peculiar to certain districts. If domestic supplies of fuel were utilized it would be unnecessary to import large quantities of fuel for domestic purposes. Efforts

should be made to utilize wood in those districts where wood can be used to the greatest advantage and so on with other fuels.

Before reading his paper on "The Gas Industry and Canada Fuel Problem," which he had had printed at his own expense for the convenience of members present, Mr. Arthur Hewitt, General Manager, Consumers' Gas Co., Toronto, congratulated the Society on the success of the meetings and upon the wisdom of taking up such an important question as that of the conservation of fuel and the available sources of supply.

The Gas Industry and Canada's Fuel Problem

The condition which prevails in Canada today, with regard to the supply of fuel necessary for the maintenance of the industrial activity of the country, and for the domestic requirements of its population, demands a careful survey on the part of governmental authorities, and that every possible economy be exercised in order that the total requirements of fuel may be reduced to a minimum.

The fuels available for use in Canada may be generally stated as coal, wood, petroleum, gas, and water power electrically distributed. Each of these fuels has certain inherent advantages and their economic value is largely determined by the service to which they may be applied, and the localities in which they may be required.

In considering the economic value of various fuels on which Canada may rely to meet its domestic and industrial requirements, manufactured gas, or what is sometimes called "City" gas, must be given an important place. Originally used only as an illuminant, gas has become one of the vital necessities of the domestic and industrial life of urban communities throughout the civilized world.

In using the term "City" gas, I mean gas as ordinarily manufactured by gas companies, and distributed through pipe line systems laid beneath highways of cities and towns. In the early days of the industry, this commodity was called "Coal" gas, for the reason that it was produced entirely from bituminous coal. The qualifying word "City" may be appropriately prefixed to the commodity as now supplied in rocognition of the fact that economic considerations have caused different localities to combine with the Coal Gas, what is known as Carburetted Water Gas. Indeed, in many cities on this continent, Carburetted Water Gas now forms the whole of the supply.

For practical purposes, however, there has been very little difference in the general character and useful properties of City Gas, during more than one hundred years.

The tremendous development and growth of the Gas industry, particularly during the past ten years, furnishes abundant evidence of appreciation by the public of the merits of the commodity supplied, and of the economy in the use of gas for the thousand and one purposes for which it is now so well adapted.

Its success in holding the market against all rivals of the same order of utility is due, largely, to its possession of certain valuable and unique physical properties, viz.:—

(1) It is a permanent gas, suitable for consumption in or out of doors, either as an illuminant or as a smokeless fuel of high or low intensity, or as a source of motive power: all from the same supply system.

(2) It is susceptible of perfect sub-division without loss of efficiency for use in either required application for lighting or the production of heat or power. The cost to the consumer is always in direct proportion to the quantity consumed.

(3) It is a readily available fuel, cleanly and inoffensive, to be obtained by the turning of a tap, which will grill a chop, boil a kettle, or heat a flat iron, and there is no metallurgical or smith's work, for which its heat is not adequate, no household warming for which it is not suitable.

City gas as supplied in Toronto, is made by the distillation of Youghiogheny and Westmoreland coal, obtained in the Pittsburgh district, with the addition of about 40 per cent of Carburetted Water Gas.

At this point it might be interesting to see what a Gas Company can secure from a ton of bituminous coal.

In the first place, a ton of gas coal in an efficient carbonizing plant will yield ten thousand cubic feet of gas, from which may be extracted a certain percentage of benzene and toluol. It will produce approximately 1,350 lbs. of coke, from which, after providing the necessary fuel for the producers, there will be left a residue of from 800 850 lbs. of coke to be marketed as fuel for steam raising, industrial purposes and for domestic use. It will yield ten Imperial gallons of tar, from which may be recovered toluol, benzene, fuel oil, acids, dyes, etc. Another important by-product is ammonia, useful in the manufacture of fertilizer, and for refrigeration and other purposes. There is also, as a minor by-product, retort carbon, which is used in the manufacture of carbon electrodes for searchlights, electrical steel furnaces, etc.

It is estimated that the percentage of efficiency obtained from coal, in a gas works, will run from 60 to 70 per cent. Compare this with the efficiency obtained in general practice from a ton of the same kind of coal used in an open fire which has just been fed with coal. Would the efficiency be 20 per cent., or less.

Let us make another comparison, and remember that the object of our discussion is to find the most economical way to use fuel, and especially coal.

The available supply of anthracite coal is admittedly limited, and the need for conservation is probably greater with regard to it, than is the case with any other kind of fuel. From every thousand tons of bituminous coal which a gas company carbonizes it produces and makes available for general consumption, as a substitute for anthracite coal, four hundred tons of gas house coke. The value of coke, as compared with anthracite coal, may be observed from the following analyses:—

	Anthracite Coal.	Coke.
Moisture (after air drying)........	3.20	1.60
Volatile combustible...	6.86	8.27
Fixed carbon....................	76.61	76.23
Ash...........................	13.33	13.90
Sulphur.......................	.92	.94
Gross B. T. U. per lb............	12,800	12,200

Gas for Lighting

Under the conditions formerly prevailing when gas was sold exclusively for lighting by its luminous flame, the criterion of its value to the consumer was its illuminating power, but since the introduction of the Welsbach system

of gas lighting by the heating to incandescence of a foreign substance in the bunsen or non-luminous flame of gas mixed with air, gas is merely burned as a fuel just as for the purpose of cooking, heating, and generation of motive power.

Gas for Cooking Purposes

Aside altogether from the cleanliness, ease of control, reliability of quantity and quality of supply, in which respects it stands pre-eminent, in point of economy there is no fuel which at prevailing prices can begin to compare with the cost of gas for certain kinds of service. If gas exclusively were used for cooking in the city of Toronto, there would be a large money saving to the consumers, but more important than this saving would be the economic advantage gained by having to import so many tons less of anthracite coal.

Gas as Fuel for Industrial Purposes

A great deal has been said from time to time as to the unsanitary conditions of the asmosphere in our city, caused by the discharge of black smoke from chimneys. In spite of by-laws, and the watchfulness of officials concerned with their enforcement, the evil seems to remain unabated, with every prospect of conditions becoming worse with the further growth of the city.

The problem of furnishing power, without making smoke, is rapidly being solved by the use of water-power, distributed by electric lines. The use of coal in manufacturing processes, however, is still to be considered. Here the gas industry offers a means for the displacement of crude heating, which not only disestablishes the chimney as a polluter of the atmosphere, but introduces into the factory itself, a controllable and uniform system of heating, producing constancy of result, and adding materially to industrial economy, by the reduction of labor, the promotion of cleanliness, and the speeding up and improvement of factory output. These aspects of the case require the main part of our consideration, but without going into details we might well consider also the great destruction of value for which the present crude methods of heating in factories are responsible. While gas can supply heat so easily controllable that there is comparatively little waste in obtaining from it effective duty, with coal there is necessarily a large waste of heat. There is a large amount of heat wasted in effecting its combustion, and in driving off those volatile constituents which are useless where high temperature and pure incandescence are required. There is also waste of heat up the chimney and through stand-by requirements. There is waste of heat every time a fire is re-charged until once more favorable working conditions of the fire are obtained. With the gas as fuel, the heat can be directed exactly as needed into the furnace, and heat losses by radiation and otherwise, can be reduced to a minimum.

I do not say that coal can be entirely displaced in factories; but I claim that a large part of it could be. The point I wish to make is, that, in addition to air pollution, our industries are largely wasting, by their crude methods of heating, parts of the substance of the country which are necessary, more necessary to-day than they ever have been.

If these statements are correct, it can readily be seen how vast an opportunity there is to benefit the country at large, if we are able in any appreciable extent to do away with this waste. In case of any doubt as to the practicability of accomplishing this result, I believe that when it is seen how much has already been done, in developing gas appliances to supplant the crude methods still so largely used, our knowledge of possibilities will lead us to believe that we see only the dawn of a new era in industrial heating.

The manufacturer has his point of view in this matter. It is not sufficient to explain to him how the use of gas will benefit the community, it is necessary to show him that it is to his direct benefit as a manufacturer, to adopt the modern methods of using heat in his processes. Some of these advantages are:—

1. Economy in space occupied by appliance, and in some cases the necessity and expense of a smoke stack is avoided; a practically unlimited choice of position for the furnace, wich enables it to be brought into close proximity to the machine workers.
2. No space required for storage of fuel, and no removal of ashes.
3. Increase in output per cubic foot of factory space, owing to economy of space occupied by gas furnaces in comparison with coal furnaces.
4. The constant and unvarying supply of fuel, of a uniform heat value, at a fixed rate.
5. Labor saving—absence of stoking, storage and conveyance of fuel.
6. Rapidity, and improved production, due to ability to precisely control working temperatures.
7. In many cases a lower capital expenditure for installation.
8. Cleanliness, which frequently assists in decreasing net labor cost.
9. No interest to be paid on investment in fuel in storage.
10. Reduced fire risk.
11. No loss of material due to inability to check a high temperature instantaneously.
12. Less repairs on equipment.
13. Enormously smaller loss from articles or materials being spoiled by irregular heat.

When these points are taken into consideration, it is really astonishing how many instances there are where the total cost of manufacturing, is less with gas, than with coal.

The following list contains but a few of the hundreds of successful gas appliances available, and in use, and while the consideration we can give to each will be necessarily brief, it will give a fair idea of the accomplishments in this field.

Baking Ovens.—The use of gas for baking bread and pastry in small bakeries, restaurants and institutions has proven very satisfactory. With large bakeries, however, although some progress has been made, there is yet much more business to be secured for gas.

Japanning Ovens.—Are of two general types—the direct heated, and the indirect heated. In the direct heated, the fuel is allowed to burn in the japanning compartment; in the indirect heated, the fuel is burned independently of the japanning compartment, the products of combustion being carried up through radiators placed at the sides of the oven, and then carried out through suitable flues. Gas is superior to steam for heating japanning ovens, where temperatures from 150° F. upward are required. Gas is superior to coal, on account of its cleanliness, time consumed in getting oven ready for baking, dust and dirt incidental to the use of coal, and for many other reasons. With the use of gas, temperatures can be exactly regulated according to requirements, while a coal fire is not capable of being so regulated.

Heating Liquids

Glue Heaters.—The heating of glue, is one of few processes where the difficulty is not that of getting enough heat, but of getting too much. Glue should not be heated over 150° F. If it is heated to the boiling point of water it is practically ruined. It is hardly necessary to say that the ease with which an exact temperature is maintained by the use of gas, puts this fuel in the first place, as a means of heating glue. The appliances are quite simple—just one or more pots of suitable size, suspended in water, the water being kept hot by means of a small burner. There is also a contrivance supplied with a mechanical agitator, which is useful in assisting to dissolve the glue.

Cauldron Furnaces.—These are constructed either round or rectangular in shape, and are generally direct-fired, in which case the gas burner is placed immediately below the cooking cauldron. Sometimes, where the materials to be heated will burn easily, a water compartment is interposed the same as with glue heaters.

Cauldron furnaces are made in sizes ranging from five gallons up to 150 gallons, and sometimes even larger. They are extensively used, and with almost universal satisfaction. Some of the uses to which they have been adapted are as follows:—

Rendering Lard	Heating Potash
Scalding Chickens	Making Disinfectants
Making Face Creams	Making Soap
Cooking Meats	Heating Water
Making Marmalade, Jellies, etc.	Dyeing
Canning Fruits and Preserves	Cooking Potato Chips
Boiling Syrups	Making Soups
Metal Polishes	Making Soft Drinks, etc.
Wax Melting	Making Catsup
Grading Oils	Pickling Vegetables
Making Pastes	

Bakers' Fryer.—This is practically the same as a cauldron furnace, except that some manufacturers supply simply a burner and frame without the cauldron, thus allowing the customer to use the same utensil which was formerly used on the coal-heated stove. It is used for frying crullers, potato chips, etc.

Confectioners' Furnace.—The success of the process of boiling candy, is mostly one of securing the right temperature. A certain amount of moisture must be driven off from the original mixture of sugar, water and other ingredients, before the proper temperature can be reached. The gas consumption varies from 1½ to 3 cu. ft. per lb. of candy, according to the temperature required.

The gas confectioners' furnace has many advantages over furnaces using coal or coke. Cleanliness is one of the most important items in a place where candy is being made. Of course, there is absolutely no dirt from the fire when gas is used. The furnace is always ready for immediate use. It makes the keeping of the factory cool, in Summer, much easier. If a proper gas furnace is used, a great deal more work can be turned out than with the best coal furnace. The heat can be regulated at the will of the operator, which cannot be done so readily with coal.

Oil Tempering Furnace.—The construction of this furnace, is along the same general lines as the cauldron furnace. Where small parts are tempered in large batches, a very good method of treatment is that of putting the articles in oil, and heating to the proper temperature. This temperature is observed by means of a thermometer. Oil which has a flash point of about 600°F. is used. When the operator has a quantity of parts to treat, he places them in a wire basket and immerses the basket in the heated oil. The oil, of course, temporarily cools, and the material is allowed to remain in the oil, until its temperature is brought back to the desired point.

Melting Metals

Soft Metal Furnaces:—Are either round or rectangular in shape, usually well insulated for economy of gas consumption, and are equipped with the burners placed to do the maximum amount of work with the minimum amount of gas. They are made with cast iron, cast steel, or pressed steel pots. These appliances range in size from 10 lbs. capacity up to as high as ten tons. The gas consumption required for melting the so-called soft metals, runs about 1 cu. ft. of gas for every 4 to 6 pounds of metal melted. Some of the purposes for which soft metal furnaces are used, are as follows:—

Melting babbit metal	Aluminum melting
Tinning	Spelter melting
Melting Linotype metal	Dross melting
" Stereotype metal	Lead melting for casting
" Type metal	Galvanizing
" Britannia metal	Solder melting

Crucible Furnace.—For the melting of such metals as copper, bronze, brass, aluminum, gold, silver, etc.—that is, metals which require a high temperature for melting, the crucible furnace is used. It consists of a cylinder, lined with refractory material. It is generally equipped with blast burners, which direct powerful jets of flame into the space between the lining and crucible. Crucible furnaces come in sizes ranging from the very smallest up to the size taking a No. 250 Dixon crucible. The advantages in melting the above metals with gas, are that uniform results can be secured, heats can be obtained quickly, and there is very slight fire risk. Decreased labor costs, etc., tend to make gas a cheaper fuel, when total costs are considered.

Steam Boilers

Gas fired steam boilers in small sizes—say up to 12 H.P.—have proved a great success where circumstances have been favorable for their use. The type most used, is very similar to the ordinary coal-fired upright fire tube boiler, the burner naturally being placed about where the bed of coal would be. While it is not pretended that with the present prices of fuel, the gas-fired boiler can compete with coal-fired boilers in large installations, yet it has proven a boon to small manufacturers requiring a small and intermittent supply of steam. Its uses are so numerous that it would be impracticable to give here a complete list, but some of them are as follows:—

Heating matrix tables,
Heating clothes pressing machines,
Steaming hats,
" umbrellas,
Shrinking stockings and underwear,
Heating steam jacketed kettles,
" rollers in various machines,
" solutions in tanks,
" shoe machines,
" coffee urns,
Distilling water,
Drying chemicals,
" blue prints and films,
Sterilizing milk cans, etc.

Forges, Ovens and Muffle Furnaces

A gas forge, consists of a metal box, lined with refractory material, and fitted with burners so placed as to project a powerful flame directly on the work to be heated. The shapes of the forges vary greatly, being dependent on the class of work to be heated. They are also made in various sizes. Gas forges heat articles quickly, uniformly and with little scale, when properly handled.

Some of the uses for gas forges are:—

Annealing gold
Manufacturing instruments
Dressing tools
Automobile repairing
Rod end heating
Iron bending
Forging
Welding
Hardening
Brazing
Cutlery manufacturing
General machine shop work

Annealing Furnaces.—Are designed to heat work uniformly. To accomplish this, the burners project the flame into a chamber beneath the floor of the furnace. The flame consequently does not come into direct contact with the goods to be heated. The products of combustion, however, pass up around the inside of the furnace and escape through vent holes in the top. They are built in all reasonable sizes, and are used for a greater variety of work than possibly any other gas appliance. They are used in all the general processes of hardening, tempering, annealing and case hardening of dies, taps, milling cutters, punches and all similar tools; cutlery, springs, screws, and in fact, practically all articles made from metal, and requiring heat treatment.

Muffle Furnaces.—Are constructed the same as oven furnaces, with the exception that a complete fire brick chamber, called a muffle, is contained in the furnace, preventing the products of combustion from coming into contact with the work being treated in the muffle. They are used principally by jewelry manufacturers and assayers.

Miscellaneous Small Appliances

Soldering Furnaces.—Are small appliances designed to heat soldering irons. Usually they are arch-shaped, and frequently insulated with fire brick. Both atmospheric and blast burners are used. Consumption runs from 10 to 15 cu. ft. per burner.

Blow Torches.—Are constructed to be used with air blast and produce a flame of high temperature. They are used by thousands, for forging, brazing, soldering, bending, preheating, etc.

China Kilns.—Are constructed on the same principles as muffle furnaces. That is, the products of combustion must be excluded from the chamber containing the work to be heated.

Machines

Corn Poppers.—Consist of a perforated, revolving steel drum, inside of a square case, in the bottom of which is placed an atmospheric burner. By an ingenious construction of the drum the material is automatically and continually fed in, and discharged when popped.

Wafer Baking Machines.—Are used by large biscuit companies for manufacturing sugar wafers, etc. These machines turn out thousands of wafers per day. The material is automatically fed on travelling plates, which pass over and under blast burners and then discharge the baked product.

Automatic Heating Machines.—This class includes some of the most ingenious appliances ever put on the market, for the heat treatment of metal, and other materials, in quantities. The work that may be done with them, is almost unlimited, and in many cases the work can be done cheaper with gas, than with any other fuel. The different styles may be used for such work as hardening mower blades, shells, pinions, balls, screws, chains, saw teeth and many other articles. They are also extensively used for annealing, tempering, brazing, coloring, etc.

Ice Cream Cone Machines.—There are in use some very cleverly designed machines for turning out that necessity of modern life, the ice cream cone.

The Use of Gas in the Manufacture of Munitions

The same causes which make gas valuable for ordinary industrial purposes apply with increased force to the manufacture of munitions. In England it is publicly admitted that the tremendous leap forward in munition manufacturing could not have been made without the use of gas. On this side of the water, while the need for gas was not vital, nevertheless gas has played an increasingly important part in munition making. At times it has been adapted solely because of the speed with which an installation could be made, but once in, it stays in, once the intrinsic merits of the fuel become known.

When munitions are mentioned, we naturally think of shells, and it is in the manufacture of shells that much of the gas used in munition works has been consumed.

In the manufacture of shrapnel every shell has to be hardened and tempered in a manner similar to the treatment of tool steel. The end of the shell must also be heated in order to forge in the end, or "nose" it. Much gas has used for this purpose, and also for heating water used for washing grease off the finished shell, and for melting rosin which is poured into the shell after it has been charged with bullets. Even the high explosive shells have required gas. It has been used in ovens for baking varnish on the inside of the shell, and in some sizes, notably the six inch, large quantities have been used in forges for "nosing in."

Comparatively large gas-fired annealing furnaces have been employed for the treatment of various parts of shells, rifles, etc. Many parts are heated in forges for various operations, some of these forges being even 25 or 30 ft. high, which shows that gas is being worked into the heavier operations.

Although large quantities of gas have been used for the purposes to which I have referred, it is not contended that other fuels could not be used, but nevertheless for various reasons, gas has been preferred. In the manufacture of small cartridge cases, however, gas is almost a necessity, and to the best of our knowledge is the only fuel used in the intricate machines which turn out millions of small cases, every one of which must be treated with absolute uniformity.

Continuity of Gas Supply in Toronto

Gas was first supplied in Toronto on the 28th of December, 1841, and from careful investigation it would appear that, while there have been local stoppages due to frost, broken mains, etc., there has not been even a momentary interruption to the general gas supply to the city since that date, a period of more than seventy-six years.

Conclusion

I shall have failed in the purpose of this paper if I do not state definitely my conviction that each class of fuel available for consumption in Canada should be selected and appropriated for the purposes for which it is inherently and economically best suited, regard being had to the essential objectives of:—

1. Limiting the necessity for importing fuel from other countries.

2. Limiting as far as possible the use of high-grade gas coal, to the purposes for which the largest percentage of its efficiency can be usefully employed.

3. Avoiding the use of fuel requiring a long haul wherever it is possible to secure a suitable substitute requiring only a short haul.

At this point the chair was taken by Prof. Gillespie, President of the Toronto Branch, who pointed out that inasmuch as the third, fourth and fifth papers on the morning's programme dealt with what might be classified as the non-urgency fuels it would be well to have Mr. Clarke's and Mr. Caldwell's papers read before calling for discussion.

Mr. F. G. Clarke, M.Can.Soc.C.E., Chief Engineer, Toronto Electric Light Co., then read his paper on

Central Heating as a Means of Conserving Fuel

This subject warrants much more time for preparation than the writer has had at his disposal. For this reason no attempt will be made to deal with it in any very definite way. Some of the salient features will be brought to your attention and if in that way discussion is invoked or provoked, the writer will feel that he has not wholly failed notwithstanding the fact that he has been unable to do the subject justice.

Central Heating is the replacement of two or more individual heating systems by one source of heat.

The electric central station and the gas generating plant are illustrations of central heating to the extent that their respective forms of energy are used in connection with heating appliances.

The use of electric energy and gas for this purpose is being dealt with in other papers which probably means that the writer is expected to deal only with steam heat distributed from a central generating plant. As the subject probably covers steam for power providing it comes from a central plant this enlargement will be made. We therefore have as our subject Central Steam plants as a means of conserving fuel by replacing isolated power and heating plants.

The first commercial central steam plant was installed by Holly previous to 1880 and although many others have taken a hand in the business, the company founded by him furnishes most of the special materials for the installations and frequently does the work of installing.

The systems installed by Holly and his successors were generally high pressure systems. There have been a few exhaust steam or low pressure systems and there is also here and there a hot water system.

The hot water system possesses advantages which, however, are restricted to local conditions.

The relative merit of high versus low pressure systems has been the subject of much discussion. It appears that the high pressure systems were originally installed before electric energy became an important competitor of the steam engine. The central steam plant was generally able to substitute its service for the boilers of the consumer and although the steam engine is no longer an important factor, the high pressure system remains in a number of large cities and probably for the reason that the generating plants have high pressure boilers and the street main cost of low pressure piping is high in comparison.

The ideal system would take low pressure steam from a steam electric power plant. The steam would be taken from the low pressure stage of steam turbines through suitable regulating valves, and be surperheated by a suitable heat exchanger before passing into the street mains.

The conditions which best suit this method of supplying heat, are a closely built up section of a city and a central location for the supply plant. The location of the station and the congested area usually give a fan like distribution system.

As an economic proposition the central heating plant can offer to customers in a limited district a supply of heat for approximately what their coal would cost them, leaving a fair return on the central heating system investment. The purchaser of steam avoids the necessity for purchasing and operating boilers, saves the space they and the fuel would occupy and is free from the troubles of operation.

Steam mains laid in city streets while not entirely free from troubles usually give ample warning of failure and can be depended upon for continuous service.

The loss of heat is a more or less constant quantity depending upon the length and size of pipe, its insulation, the difference in temperature of steam in the pipe and the surrounding earth, and the leaks. The nearer to capacity the mains are worked the smaller is the percentage of loss. A well designed system as for example one covering that part of Toronto between the bay and College Street and from Sherbourne to Spadina Ave., if supplied from a central plant such as the Scott Street Station of the Toronto Electric Light Co., would be able to furnish all of the heat required in the district at a cost to the users from 10% to 30% less than their present expense. The saving in coal might be over 30% but in any case the cost of coal at the central plant would be sufficiently less than its cost delivered throughout the district to offset the fixed charges and heat losses of transmission through the streets.

On the assumption that 75 tons of Anthracite at $9.00 and 150 tons of Bituminous at $7.00 per ton is used in the district each week day for six months and proportionately smaller quantities during the remainder of the year, the cost of steam under present conditions would be over $500,000 per year, of which the coal cost is about $400,000.

The central heating company would be willing to supply an equivalent quantity of heat for the cost of the coal depending upon their own saving in coal and its cost to meet expenses and pay a dividend.

The conditions throughout Ontario and the populated parts of Quebec are ideal for the development of central heating plants because of cheap electric power, the number of heating days and the high price of coal. Every town of 10,000 or more inhabitants and with buildings not too widely scattered affords an opportunity for saving coal if it will support a well designed and well operated central heating plant. The smaller towns should depend upon hot water circulation, the water being heated during the

hours when electric energy could be taken from steam engine units used to produce the exhaust steam needed for heating.

The Hydro Municipalities could use some of the energy they have been expending upon the radial railway scheme in the solution of this problem, and produce an economic saving of value to themselves and the country.

The writer would not care to make an estimate as to the saving that would result from a comprehensive establishment of central heating plants throughout the country. It is altogether improbable that any installations will be made in the immediate future. The idea of cheap hydro-electric power unlimited in quantity and in its capacity to replace coal has so taken hold of the people of Canada and of Ontario in particular, that they are simply waiting for the end of the war or the completion of the Chippewa development to heat their buildings electrically and thus entirely do away with coal.

The writer will, however, venture one prediction which will have a considerable bearing on the question of central heating or rather on heating in general.

It is that within ten years, gas and coal briquettes will replace the anthracite and bituminous coal now used and that the gas and the briquettes will be made from powdered coal sent from the mines to Hamilton or Toronto or London in pipes just as oil is now pumped from Oklahoma to the Atlantic Seaboard.

The cost of the gas and the briquettes will be less than one-half and possibly one-fourth the present prices for gas and coal.

What the situation with respect to central heating will then be is left to the imagination of the reader.

Mr. R. W. Caldwell, Chief Mechanical Engineer, Imperial Oil Co., Sarnia, Ont., read his paper on

Oil Fuel and the Possibilities of its Use

The subject is a large and complex one and it will be impossible in the time at our disposal to go into it in all its phases.

The principal uses to which oil fuel is put today are for the generation of steam in boilers and for metallurgical work of various kinds; also for use in internal combustion engines of the Diesel type.

Where one considers the fact that petroleum oil was first discovered in the United States in the year 1859 and it was not until a good many years after that that its extensive distribution over the globe was found to exist it would be a difficult matter for anyone to estimate the possibilities of oil fuel as a producer of heat and power in the years to come and particularly on this continent, whereabout 75% of the world's output of crude petroleum oil is produced. Canada only produced about .05 of 1% of the world's total in 1915 and has certainly not increased that percentage since and as this amounted to only 215,464—35 imp. gal. bbls. you can understand from figures given you by previous speakers, how dependent we are on foreign countries at present for our supplies of fuel oil which have increased for industrial purposes from 1914 to 1917 by something like 135 per cent and any means that can be adopted to use not only fuel oil, but all other fuels, so as to get the utmost economy and efficiency in their use, should be carefully considered in this crisis through which we are passing. It will not only assist us today, but would be also a factor in the economic development of our industries after this war is over.

Oil fuel can be used anywhere that solid fuels are used and with a great deal more efficiency as well as cleanliness. It can also be controlled a great deal easier than solid fuels can, the turn of a wheel or handle being sufficient to either increase or decrease the intensity of the fire required at any time.

The handling of oil fuel into storage as against solid fuels is another feature which one might here consider, the former being handled with ease and cleanliness, while the latter usually requires hard labor with resulting uncleanliness, unless one is equipped with expensive machinery for unloading, which is not usually the case in the average plant. Oil fuel is also a safe fuel to handle when the equipment for handling and storing it is properly installed. The storage tank from which the supply is drawn for the burners should always be placed below the level of burners by several feet, drawn from the tank by a pump and the excess amount of oil pumped through the line returned to the storage tank through a relief valve which is set at the proper working pressure. This ensures a constant pressure at the burners at all times and when once regulated requires but little attention by the operator. In fact, there are installations today in which automatic regulation is used and there is no fuel which lends itself so well to automatic regulation as does oil fuel. To illustrate the safety of oil fuel—investigations made at the time of the eathquake in San Francisco a few years ago showed that only one fire was directly traceable to the use of oil as fuel. Coal when stored in large quantities is susceptible to spontaneous combustion with resultant loss and danger of fire, which is not the case with fuel oil, which will not ignite by spontaneous combustion.

The principal uses to which oil fuel is put today in Canada has been stated above. We are here interested particularly in the use of fuel oil for steam raising and metallurgical work and I will confine my remarks to these.

The composition of petroleum oil is of such a complex nature that it would require one to make it a life study to acquire a thorough understanding of its chemical make-up and possibilities, but it will be sufficient for our purpose, in connection with the use of fuel oil for heating and power purposes, to know its composition from this standpoint or in relation to its heating value as a fuel. Fuel oil is obtained from crude petroleum oil by destructive distillation. The lighter products, such as gasoline and Kerosene, are distilled off in order that they may be conserved for other important purposes, and also that the flashing point of the resulting residue of fuel oil may be raised to the safety point of at least 150°F.

A great many of the Southern and Western Oils are not suitable for making lubricating oils and are therefore used almost entirely as fuel oil. Typical are those of California and Mexico.

Fuel oil is a combination of carbon and hydrogen, together with a small percentage of oxygen, nitrogen and sulphur.

The fuel oil obtained from the different fields on this continent vary from very viscous, heavy Oils of a gravity of 13-15-16 Beaume to the lightest oils of 28° to 30° Beaume. In Oils from the same source the heavy oils invariably contain less Hydrogen than the lighter oils and also invariably contain less B. T. U's per pound, but as oil is usually, in this country, sold by measure and not by weight the amount of B. T.U's in a specific quantity of the heavy oils will usually exceed those in the lighter gravity oils.

For instance, an analysis of 14° Beaume gravity heavy Fuel Oil shows the following contents:—

Carbon	82.17%
Hydrogen	10.18%
Sulphur	3.80%
Oxyge, Nitrogen and Undetermined	3.85%

And its heating value—18,163 B. Th. U's per lb. or 175,544 B. T. U's per Imp. Gal.

And a light gravity oil 32.6 Beaume would have the following contents. } Flash 150° F. Visc. 40 at 100° F.

Carbon	84.91%
Hydrogen	12.72%
Sulphur	2.04%
Oxygen	.33%

And heating value, 20,340 B. T. U's per lb. or 175,127 B. T. U's per Imperial Gallon, or a difference of 1,417 B. T. U's per Gal. in favor of the heavy oil—both of above Oils being from the same source of supply.

It is very apparent then that the heavier oils, if properly consumed, are the cheapest : not only do they have a higher calorific value per gallon but they can usually be purchased at a less cost per gallon than the lighter grades of oil.

The heavier oils are used more for steam raising purposes, because of the fact already stated that their heat value per gallon is higher, and also on account of the fact that they do not as a rule have to travel any distance between the supply tank and the burners, and can be preheated on their way to a high temperature thereby making them as fluid as the light oils, and as easily atomized so that they combine with the air for combustion properly, and are consumed in a satisfactory manner.

It is absolutely essential in burning oil fuel that it reach the burner in a free flowing fluid condition otherwise it cannot be properly atomized and consumed. With the lighter oils heat is not generally necessary except probably in the coldest of winter weather, in order to obtain this result, but with the medium and heavy oils according to their degree of viscosity more or less heat has to be applied to them (even in hot summer weather) in order that they be rendered sufficiently fluid to be properly atomized and consumed. Oils from different localities vary greatly as to specific gravity and viscosity but their chemical constituents do not vary very much. In consequence, oil fuel is more uniform in its calorific value than any solid fuel. The lighter oils are richer in hydrogen than the heavier oils and invariably contain more B. T. U's per lb. but as stated previously for a specific quantity the heavier oils contain more B. T. U's than the lighter ones.

The following are the analysis of some of the fuel oils produced on this continent, and you will note that while as stated before, their gravity varies considerably, the principal constituents carbon and hydrogen vary but slightly; while their viscosities would vary from about 1,100 to 40 secs. at 100°Fahr.

	Texas Crude Medium	*California Crude Heavy Oils*	*Mexican*	*Oil*
Carbon	84.60%	85.64%	82.17	84.91
Hydrogen	10.90%	11.37%	10.18	12.72
Sulphur	1.63%	1.06%	3.80	2.04
Oxygen	2.87%	.84%	3.85	.33
Beaume Gravity	22.17	14.37	14.8	30.8

It may be of interest to give you a little retrospect of what has been done by those who first tried to burn oil as a fuel. As far back as 1861 attempts were made to burn oil fuel in Russia, and the apparatus ultimately settled on after different contrivances had been tried, was a series of griddles over which the oil flowed, and burned. In 1862, the use of petroleum for heating and power purposes was tried on this continent, the first attempts were made to burn oil in pans. This method is being used with succcess even today for the melting of metal in crucibles. There are usually two or three sets of pans the one above the other. The oil flows into the top pans, and trickles down into the second and third rows, through a pipe at the end of each series of pans, and according to the intensity of the heat desired, the flow of oil into more or less of the pans, in which it is burned, is controlled. These pans are set up in tiers in front or mouth of the furnace and the air for combustion passes over the pans to consume the oil properly, at whatever rate may be required. The regulation being done by dampers in the flues.

In the year 1863, the first spray furnace was introduced in this country, which was a vast improvement over the previous methods.

In the year 1868, experiments were made with an Aydon & Selwyn burner in England. This burner was one in which superheated steam was used as the atomizing medium and was undoubtedly the best burner introduced until that date. It was of the outside mixing type and if accounts of Selwyn's experiments are correct there has been no burner introduced to date of any kind that has shown any better results as an evaporation of 16.9 lbs. of water from and at 212° F. was obtained with it. This evaporation is remarkable if it is true. The result of a test made in 1910 with a Hammel Burner which is of the inside mixing type showed an evaporation the best of a series of which was 15.81 lbs. from and at 212°F. equal to 83.3% efficiency with a consumption of steam by the burner for atomizing purposes of 2.4% of the total generated which is a very economical performance, excess air was 10.6% and carbon dioxide 14.3%, oxygen 1.8%, flue gasses 406.2°F. Draft in ash pit 0.044 inches. Oil used at this test was California 13.3 Beaume gravity. Temp. of oil to burner line being 142.3° F.

The burning of fuel oil for steam raising purposes has been, in up-to-date installations, attended with fairly economical results and efficiencies of 80% should not be uncommon where care is taken in their operation and maintenance, and 75% would be quite an ordinary performance.

In order that oil fuel be burned efficiently, it is necessary that it be properly atomized, and there are several types of burners in use for this purpose today. Those using fan blast air, which may be anywhere from 8 to 14 oz. pressure. Low pressure air from 1½ to 2 lbs. per square inch. These two types are used chiefly in heating and forging furnace practice and are of the outside mixing variety. High pressure oir and steam both outside and inside mixing variety and the mechanical or pressure jet burner in which neither air or steam is used. A burner of the outside mixing type is one in which the oil and spraying medium combine outside of the burner and the inside mixing type is one where the oil and spraying medium combine inside of the burner.

With the mechanical or pressure jet burners, such as the Wallsend, White, etc., the oil is drawn from the supply tank and passed through a heater which heats the oil up to near its vaporizing point, and is forced in this condition

through a nozzle at high pressure which gives it a spiral motion, and injects it into the fire-box in the form of a mist. The air for combustion being either admitted through openings in the front of the burner or the ash pit doors, in the case of natural draft. Or, if forced draft is used, by fan into the closed ash pit.

The air and steam jet burners are very noisy in their operation while the mechanical or pressure jet is directly the opposite, being comparatively noiseless and developments with this type of burner on this account are not unlikely. This system is used extensively in Marine practice with very efficient and economical results. The pressure jet burner is used in marine practice particularly because of the fact that no steam is used for the atomization of the oil other than that which is used to operate the pumps which force it to the burners and is a very small portion of that generated, and as it can be condensed and used over again it is not consuming fresh water which a steam jet burner would do this being as important feature.

Tests with all three types of burners, air, steam and pressure jet show that the air and pressure jet are the most efficient, although some makes of steam jet burners have shown quite as efficient results, and I am of the opinion that if any better results are to be obtained it will be more in the design of the furnaces than in burners.

In forging or heating furnaces the fan blast burners seem to be the favorite, and it is in this particular class of work that there is room for a good deal of improvement.

I had occasion to make quite a number of tests in heating and forging furnaces to ascertain the relative heating qualities of different grades of fuel oil. The furnaces with which these tests were made were those used daily in the various plants in the prosecution of their work and were not altered or prepared for them in any way. The results of these tests showed that the amount of metal heated, per Imperial gallon of oil consumed, from normal temperature to a forging temperature, varied all the way from 34.5 lbs. to 43 lbs. in heating furnaces where flat metal was heated to welding temperature in a furnace with an open throat. In closed furnaces heating faggots to welding temperature the weight of metal heated per Imperial gallon of oil was from 37.8 to 50.7 lbs. This test was made with an oil pressure 30 to 40 lbs. per sq. inch and air pressure of 9 oz. And in closed furnaces heating shell billets to forging temperature the weight of metal heated per imperial gallon of oil consumed was from 90 to 107 lbs. oil pressures varied from 30 to 35 per sq. inch and air from 6 to 13¾ oz.

The furnaces operating under pressures of air of from 8 to 13¾ oz. were more efficient than those operating on the lower pressures. You will readily see from these figures, which represent the quantity of oil consumed for heating only and do not take into consideration the heat supplied to the furnaces during the operation of drawing the charge, that the efficiency of the average furnace is not high, and while there is no doubt much better results are obtained in some cases, there is room for a vast improvement in the average installation.

In the average installation for the burning of fuel oil in furnaces, I find that no provision has been made for the return of fuel oil to the supply tank from the piping system. Pipes are simply run from the oil pump to where the last furnace happened to be placed and stopped there. This system was bad enough when light fuel oil was procurable in sufficient quantities for all needs, but in these days when so much is being consumed due to the requirements for making munitions it is a practical impossibility to get these light oils, and the heavier grades have had to be resorted to in order to meet the increased demand and it is here where the trouble arises. As stated in a previous part of this paper it is absolutely essential that oil to be burned properly and economically should reach the burners in a free flowing limpid condition and unless the oil in the pipes which supply the burners is in this condition by the application of heat when necessary and makes a circuit back to the supply tank, containing heated oil, so that free flowing limpid oil be kept circulating through the system, and reach the burners in this condition, it is entirely out of the question to expect good results.

To illustrate the trouble that may arise from a dead end system of piping. I know of one plant where they had a leak in the oil suction line and where the overflow from the relief valve was returned to the suction line, furnaces at different points would spit and work badly due to the presence of air pockets in the line. The pipes were connected to form a circulating system back to the tank and no further trouble was experienced.

In the making of steel in open hearth furnaces where fuel oil is used, the burner used is of the air jet inside mixing type and is swung on a trolley one at each end of the furnace so that as the heat is required to be concentrated at one end or the other the burners are used accordingly. These burners operate with high pressure air and oil, and maintain the metal in the furnace at somewhere about 2800° F., the consumption of oil per net ton of metal produced being from 40 to 50 imperial gallons.

Oil fuel is an ideal fuel for all purposes. It will never be a competitor of coal to any extent unless the production of oil is materially increased, but it will always be and certainly is a splendid supplementary fuel to coal. The locality and conditions as to the oil and coal markets will always be a factor in its adoption for steam raising purposes in stationary or heating plants. If it was more extensively used we would have cleaner cities due to the absence of smoke from coal fired boiler plants, as with a properly operated oil fuel plant there is an entire absence of black smoke, and the health and cleanliness of the community would be benefitted thereby.

The Imperial Oil Limited have spent several millions of dollars in the erection of refineries for the purpose of the production of fuel oil. Two of these refineries in particular are, or will be engaged in this line of production. One at Montreal and before long one at Halifax, where besides fuel oil being produced, road oils and asphalts are refined for road making purposes and while the present conditions due to the war which we are engaged in, has affected the fuel oil market to such an extent that until it is over and we are able to get the use of our steamers, some of which have been commandeered for Government business, we cannot hope to encourage the use of fuel oil other than for necessary purposes in the manufacture of war material for which purpose the bulk of the fuel oil being consumed in Canada at present is being put in our endeavor to beat the Hun, which at the present time is about the only thing that matters, but when things again become normal, we hope to have the production of our plants for use in the generation of steam for the heating of office buildings, etc., as well as the heating and melting of iron and steel for which purpose it is being used extensively today.

The Imperial Oil Limited have a heating installation in operation at their building on Church Street and are using fuel oil exclusively for this purpose.

The installation is known as the Simplex Rotary Crude Oil Burner, and is a very compact and efficient one, the control of the air and oil being so arranged that if for any reason the power ceases, both oil and air automatically stop.

This burner works on the centrifugal atomization principle, the oil being thrown by centrifugal force to the outside edge of a cup revolving a high speed. Between this cup and the shell of the burner is an annular opening, through which air is forced which atomizes the oil.

This installation has given very good results in the heating of our office building on Church Street in this City, the amount of oil consumed on the coldest days experienced this past winter, being 19.4 Imperial Gallons per hour, while as the weather moderates this would be reduced pro rata. The amount of radiation in the building is 10,900 sq. ft., which, with all auxiliaries, would represent a radiation of about 12,700 sq. ft.

If any of you gentlemen here are interested in installations of this kind, the Imperial Oil Limited, through me, extend a cordial invitation to you to visit their building to see this installation.

Discussion on Gas, Oil Fuel and Central Heating

Prof. Gillespie—"Any method of industrial heat which eliminates smoke and which makes for ready availability or better control than the present method will certainly appeal to the consuming public. We have had read this morning three papers which describe three methods of this kind, which should provoke some illuminating discussion. The meeting is now open for general discussion."

Mr. Arkley asked if Mr. Clark had considered the question of putting in an ice plant and making ice from the absorption system by means of the exhaust steam in the summer time. He requested further information regarding forcing pulverized coal through pipes. Mr. Clark in reply to the first question said that the matter had not been given much consideration but he heartily concurred in the suggestion and believed that the efficiency of an exhaust heating plant would be increased by making ice in summer where it could compete with natural ice. Regarding pumping coal through pipe lines he believed that coal could be pumped as far as the pipes could be laid.

Mr. Mickle referred to the main conclusions of Mr. Hewitt's paper which were to the effect that it was desirable to devote each standard of fuel to the purpose for which it was best suited. He gave information regarding the natural gas production in Ontario which was equivalent to 830,000 tons of coal of which less than 40% was used for domestic purposes. An act had been passed at the last session of the Provincial Legislature restricting the use of natural gas to domestic purposes. Dr. A. Stansfield in commenting upon Mr. Hewitt's excellent paper asked the question as to what extent it would be possible in the future to secure coal at a sufficiently cheap price for running, for instance, an assay furnace in competition with coal. He desired to know what proportion of the price paid for gas is really chargeable to using the gas and what part due to the cost of distributing it through small pipes in the streets. The cost of gas at the present time was much larger for this purpose than the cost of coal. He suggested that cooking stoves could be modified to advantage for the use of gas. Mr. Arthur Hewitt replied that a great deal of information given by Mr. Caldwell in regard to oil applied with equal force to the use of gas as a substitute for coal. While gas is not as cheap as coal, say in an assaying furnace, it is possible to eliminate waste to a greater extent than it is possible in the use of coal so that gas will have advantages over coal even in such a case. Referring to the cost of gas, compared with coal, for cooking purposes he was able to make a positive statement that the use of gas per individual household for cooking was below the cost of coal for the same purpose. He was hopeful, that with the rate of gas somewhat lower than the price of gas at the present time, that the use of gas for heating residences was quite within the realm of possibility. The gas manufactured in the city of Toronto alone, putting it on a coal basis, would be 500,000 tons. Remembering that the by-products of the distillation of that coal places on the market an enormous quantity of useful domestic fuel in the shape of coke, together with a number of other valuable by-products, would give a clearer idea of the value of the gas industry. As a means of conservation, they were warning the customers against wasting gas. Prof. Angus stated that the fuel difficulty was due to several causes, one an actual lack of fuel, a second the difficulty in transportation and third serious waste of fuel. Greater economy should be effected by using apparatus that was economical in its use of fuel. He thought that educational work was necessary in connection with this, that the people should be shown how to run their furnaces economically and to burn gas economically. A Committee of the Society might be appointed to do valuable work along this line. Mr. A. Dion confirmed Mr. Hewitt's statement that Canadian users had been well treated by the coal producers in the United States and by the United States Government. His company in Ottawa had been supplied with fuel last winter when people in the United States were suffering. The use of gas contained greater possibilities for the economical use of our natural resources than other fuels. He agreed with Mr. Clark regarding the present impractibility of the use of electricity for heating houses. The outlook for the present in that direction was practically hopeless. Mr. E. Stansfield believed that surface combustion would lead to an increase in efficiency in the burning of gas. He suggested that the principal of fireless cookers, applied to the installation of ovens for ordinary cooking, would make for greater economy. He protested against the use of gas fires without chimneys. He believed that houses could be heated very efficiently by gas fires, either by a central plant or a separate unit for each room. Mr. White, referring to the possibility of a fuel shortage next winter, stated that in one week last winter one hundred municipalities in different states of the Union had memorialized the Fuel Controller of the United States to stop the exportation of fuel to Canada which showed the splendid treatment we had received from the United States during the past winter. If we were correct in our assumption that there will be a shortage of fuel in North America next winter then we must do our share. The Northern States and the New England States are laying in stores of wood for fuel and we should do our share and utilize any fuel we have available to the best advantage. Mr. P. H. Mitchell pointed out in connection with central heating the saving that could be effected by burning bituminous coal in a central heating plant to supply an entire block. By having the heating unit for a group of houses concentrated in one plant the result would be cleanliness in the cellars, the saving of money and the saving of coal. Mr. J. W. Hayward confirmed Mr. Mitchell's view and mentioned that in connection with the central heating plants, each house should be charged with exactly the amount of heat it uses, following which Mr. Mitchell

stated that from his own experience in the operation of a central heating plant it was an easy matter to meter the heat for each house or apartment; thus every householder secured the advantage of any saving effected in the use of heat.

Discussion of Mr. Hewitt's Paper

By James Milne, M.Can.Soc.C.E.

An indispensable condition of any public utility, should be continuity of service. A record of 76 years continuous supply, not even a momentary interruption, is one that must make electrical concerns turn green with envy.

There is only one other utility that can be compared with this, and that is the water supply of a large City where gravity is the source of supply. Next to this comes a steam operated pumping or electric station.

No Hydro-Electric scheme, and by this I do not mean in particular the Ontario Hydro-Electric System, I mean all Hydro-Electric systems, can ever hope to have such a record as this for continuity of service.

Our transmission lines are long, and interruptions from various sources varying from minutes to several hours occur about 75 times per year. Truly a poor record.

Power users can readily see the great inconvenience and loss arising from this state of affairs.

There is scarcely an industry today, where gas does not perform some important function. Electricity, no doubt, forms an important factor in our economic existence, but I think that gas forms just as important if not more so.

It was thought when electricity was introduced, the death knell of the Gas Companies was sounded. Since then, however, the gas companies have gone ahead by leaps and bounds, and more so than electric companies.

For general heating purposes, I do not think electricity will supplant gas.

Why even to making our toast in the morning, when the voltage is so low that the electric toaster is inoperative, we finish the operation by using the gas stove.

The list of industries Mr. Hewitt gives as using gas for various functions shows conclusively, gas is more than holding its own.

Electric power, however, has done great things, and will still do greater in the reduction of the importation of bituminous coal for power purposes, and the sooner the scenic side of Niagara is sacrificed, and the maximum power developed, the better it will be for all concerned.

We see occasionally in the papers about the time having arrived, or will soon arrive, when all the houses will be heated electrically. Some rough figures in this connection will no doubt be interesting.

In Toronto, we have say 90,000 houses consuming at least one (1) ton of anthracite coal per month for seven months of the year on the average, for heating purposes only. This is equivalent to 630,000 tons for the Winter months.

If electricity were to replace this, what power would be required? To answer this question one must consider the maximum demand which, of course, would occur in "below zero" weather.

The maximum demand would undoubtedly be double that of the mild weather demand, or at the rate of two tons consumption per month. This is equal to 180,000 tons per month = 6,000 tons per day, = 250 tons per hour. Now one ton of coal of the quality we are at present getting, contains say 24,000,000 Heat Units. Allowing 30% of this to be actually accounted for in the various heating systems in vogue, we have 7,200,000 Heat Units accounted for per ton of coal burned.

Mr. Hewitt mentioned 20% for the efficiency in open grates. No doubt this is near the mark for this method of heating, but for the purpose of this discussion, I think 30% a fair average. To furnish heat equivalent to that given given by one ton of coal with 30% efficiency will require 2,819 H.P. As the rate of consumption in Toronto is 250 tons per hour, then 704,750 H.P., would be required to heat the houses electrically.

If the efficiency of the heating systems is greater than that above stated, then the greater the amount of electrical power will be required. Under extreme conditions, I would not be surprised if the amount of electrical power required for house heating would be about 1,000,000 H.P.

At present, we are using about 100,000 H.P. for power purposes, with many interruptions. The prospects, therefore, for electricity supplanting coal for house heating is remote. The prospects of using gas, however, for this purpose is not so remote.

A friend of mine two years ago installed an automatic gas water heater in his house, and while this was the first of its kind, it has done good work. From this you can readily see, there is an enormous field.

By substituting gas for house heating purposes a great reduction in the consumption of anthracite coal can be effected. For cooking purposes, I cannot see why anyone at this date should use coal.

It may be contended that by using coal, in the Winter time, we can get all the hot water from the stove for nothing. This is all wrong. There is very little these days that one can get for nothing, and hot water is not one of these.

In my own house, I get all the hot water throughout the whole year for less than .10 cents per day, with an automatic gas heater. This device has never failed. It will give you all the water you desire for as long a time as you wish, and when not required the gas is shut off.

In cooking, I think it was R. E. Crompton, Chelmsford, England, that established the fact that the ordinary cooking stove gave an efficiency of about 2%. 12% is wasted in obtaining a glowing fire, 70% goes up the chimney, 16% lost by radiation. Truly a very poor performance. In the case of an electrical oven, 90% of the heat energy can be utilized, and while 5 to 6% of the heat energy is present in electrical energy, 90% of this 5 or 6% is 4½% of the whole energy, which actually goes into the food.

This shows that the electric oven is about twice as economical or as efficient as the coal, or perhaps as the gas, because we have in the gas the same set of losses as with coal. Further, in cooking by electricity, the loss in meats is very much reduced than by other methods.

In spite of this, however, gas still holds the field. The progress in electric cooking has not been as rapid as was expected. This, no doubt, is due to the high cost of the equipment, the frailty of the elements, and the uncertainty of service. All these drawbacks may have a bearing on the subject.

There is no reason that I see, why anthracite coal should be used for cooking purposes in the cities where there is a gas supply.

If Mr. Hewitt's statement is correct that $2,000,000 can be saved in Toronto annually, if gas were used

for cooking purposes exclusively, instead of anthracite, I think it nothing less than criminal that this condition should exist.

From Mr. Hewitt's paper, we note that from a ton of gas coal are obtained,

10,000 cub. ft. of gas,
1,350 lbs. of coke
(part of which is used in these producers, leaving some 850 pounds for sale.)

10 gallons of tar,
(from which are extracted valuable dyes, acids, etc., also ammonia.)

In other words, a modern gas works is on a par with a modern pork packing establishment, where only the squeal goes to waste, and that I understand, in Montreal, is being recorded on the Phonograph.

The only waste, and that is trifling, around a gas works, is a slight perfume, something similar to that from the Morley Avenue Sewage Disposal Works. Not at all unpleasant.

Beyond doubt efficiency stands high in gas production, and nowhere than in Toronto does it stand any higher. I know of no city in Canada where gas is sold at a lower price.

Where efficiency stands high so must continuity of service. Electrical concerns have a long way to go in this respect unless their plants are operated by steam. Where electrical energy is dependent on,

(1) Long transmission lines under one control,
(2) Generation of power under another control,
(3) Distribution of power still under another control,

it is not to be wondered at that failures are frequent. Is there any reason on God's earth why we could expect a steady service?

The Gas Company, in Toronto, has given a service during these hard times that is not appreciated by the general Public. Consuming as they do to my knowledge, some 800 tons of coal per day, the management deserves great credit for keeping up the supply.

No interruptions in 76 years. Some record.

Of course, it may be contended that gas lends itself readily for storage so that continuous service may be obtained.

The same remark applies to water works, and it should apply to all utilities, including electrical power, and all means known to the art should be used to give this uninterrupted supply.

Electricity has done a great deal for Canada in reducing the importation of bituminous coal. The general use of gas for cooking and heating will do much towards reducing the importation of anthracite. Electricity also can do a great deal in this respect, and there is no reason why between these utilities, the use of anthracite coal should not cease for domestic purposes, or be very materially reduced.

I noticed, a short time ago, an article by some London Ontario, writer, that the average house would require 20 H.P. to heat it electrically. This estimate is higher than mine, and is based upon 2 H.P., for every 1,000 cubic feet of space to be heated. This be given as the minimum power. Such being the case 1,800,000 H.P. would be required for Toronto alone.

Government reports state that Ontario has about 7,000,000 water H.P., and if heating was to be exploited, there would not be anything like the quantity required "to go around".

In a report for the Government by Professor Nickle, entitled, "Natural Gas Situation in the Counties of Kent, Essex and Lambton", I find that the total importation of anthracite into Ontario for the fiscal year 1915-16, was 1,827,000 tons. This fuel is used for domestic purposes outside of the consumption of wood, natural and artificial gas. This is over a ton per capita, and shows that the figures I have given above as applied to Toronto are not very far out.

I do not think there can be any doubt about this fact that over 1,000,000 H.P. would be necessary for heating purposes in this City.

What would the consumption of gas be if all conditions were favorable to heat the residences of Toronto?

The thermal value of the gas is about 600 B.T.U's, which with equal efficiency would measure 40,000 cubic feet for one ton of coal.

There is no reason why the efficiency of the gas heater should not be considerably higher than the coal fired furnace.

For the purpose of the discussion, I will assume,

1 ton of coal = 30,000 cub. ft. of gas.

It therefore follows that to take the place of all coal burned for heating purposes in residences there would be, 500,000 tons x 30,000 cub. ft. = 15,000,000,000 cub. ft. of gas, or 75,000,000 cubic feet per day for 200 days. Quite a large order even for the gas company, but not outside of the bounds of possibility.

Mr. Hewitt's paper shows the multitudinous application of gas in our every day affairs, and so far as I can see, no matter how great and rapid the growth of the electrical concerns will be, gas is here to stay. The service cannot be surpassed by any other Light, Heat & Power business today.

Afternoon Session, Wednesday, March 27th

Prof. Gillespie, who occupied the chair, introduced Mr. Frank Yeigh, Secretary of the War Lecture Bureau, who gave a brief address on the activities of that branch of the service.

Mr. Yeigh explained that the War Lecture Bureau had been established by the Canadian Government about three months ago to give additional information to the press and to the public regarding our aims and objects in the war and to keep us in a spirited pitch in our attitude to the war, to remove ignorance, to eliminate indifference and to fight pro-Germanism. "In the general matter of war propaganda," continued Mr. Yeigh, "we are realizing, in part, the undoubted fact that Germany has outdistanced all the Allies. While Germany was carrying on her insidious campaign in Russia, distributing literature to millions of Russians in their own language there had been not a single line of type to answer it from any allied country. We were familiar with the more recent campaign carried on by Germany and Austria in Italy where papers were printed in the Italian language which brought about the disintegration of the Italian army. Germany's propaganda has been deadly and insidious and not blundering like their diplomacy. While in Italy the German propaganda had been sly and secret it is being carried on in Spain at the present time in a manner defiant, aggressive, contemptuous and cultured. It is being aimed to pillory Uncle Sam and

John Bull side by side. We were not alive to the deadly possibilities of German propaganda." He quoted from the address given by Mr. J. Murray Clark, in which he said that if all the Allies would act vigorously and energically against pro-German agencies and the German propaganda in the United States and Canada hundreds of thousands of lives would be saved. Judge Gary had stated that it was not exaggeration in saying that efficiency and promptness at the present juncture in offsetting this current German propaganda would save millions of men and millions of money. There were evidences that some of the coal strikes in Canada and some of the industrial disturbances could be traced to German propaganda and to German gold. If we knew all the activities in this connection we would probably be greatly surprised. It was necessary to point out the danger and put people on their guard. He asked for the co-operation of the engineers, stating that any help that could be given to offset German propaganda would be received as a patriotic service.

Following Mr. Yeigh's address a photograph of the members present was taken at the main doorway of the Physics Building.

The Chairman suggested that it would be advisable to follow the procedure in the afternoon meeting of the previous sessions in having the papers read before calling for discussion. Mr. J. B. Challies, M.Can.Soc.C.E., Superintendent, Dominion Water Power Branch, Dept. of Interior, then read his paper on

Canada's Water Powers and their Relation to the Fuel Situation

The subject assigned to me in connection with this fuel-power symposium Meeting of the Canadain Society of Civil Engineers is the relation of water power to the fuel situation in Canada. At first "blush" it might appear that water power has only an indirect and limited connection with the recent critical fuel shortage which through suspended effort has caused temporary industrial stagnation and local domestic hardships of enormous extent and involving great financial loss. Even a casual general survey of our fuel-power requirements, however, will indicate that not only has water power a very direct and important bearing on the present situation, but that water power must, in the future, take a very much greater share in our fuel-power burdens.

Heat, Light and Power Needs—One problem

It is axiomatic that our heat, light and power needs must be considered as one great national problem, and also that Canada's domestic and industrial development depends primarily on the co-ordinated use of all the fuel-power resources of the Dominion.

Development along independent and divergent lines has, in the past, prevented adequate correlation of the great Canadian industries of fuel production and hydro-power supply. There is now, however, as a result of the fuel shortage, developed a concensus of opinion among men familiar with fuel and hydro-power matters in Canada, that there is between these allied industries, enormous scope for national co-operation which would be conducive to their mutual advantage, as well as to the common weal.

I propose to show:

First,—*That water power must take a very prominent part, if the best use of the varied fuel-power resources of Canada is to be achieved, and*

Second,—*That there must be evolved a national master fuel-power policy which will realize the best possible co-ordinated and concomitant development and use of all the fuel-power resources of the Dominion.*

Interdependence of Water Power, Coal, Wood, Peat, Oil and Gas.

Within the last two days we have had recognized experts describe the possibilities and proper functions of our different available fuels—coal, wood, peat, oil and gas. Practically every speaker has indicated their interdependence and their interchangeability of use. It remains for me to demonstrate the relation of "white" coal to all other fuel-power agencies, and to point out that they must all "coalesce" in meeting the fuel-power requirements of the country.

To furnish a quick general summary "bird's eye view" of the "white" and black coal situation in Canada, and to indicate their integrality, I have had several maps and diagrammatic statements specially prepared for submission at this meeting.

Pacific and Atlantic Provinces Self-Sustaining, But Central Provinces dependent for Coal

Plate No. 1 represents the coal consumption and production in Canada. The tabulated statement on the top of the plate summarizes the consumption in the various provinces of the different classes of coals, both domestic and imported. You will observe the greatest consumption is in central Canada, including the provinces of Manitoba Ontario and Quebec. Coal production is greatest in the extreme western and eastern provinces. British Columbia and Alberta on the one hand and Nova Scotia on the other not only meet their own coal requirements, but produce a very considerable overplus for consumption in the contiguous portions of Central Canada. The central provinces, Manitoba, Ontario and Quebec, are almost wholly dependent on outside sources, mainly imported coals. This is clearly shown by the hatched areas on the map, the horizontal hatching covering the areas which produce their own needs, the vertical hatching covering the areas which are dependent. Where there is cross-hatching both Canadian and imported coals are consumed. It is to be observed that central Canada, where consumption is greatest, is non-productive. This I have termed the "acute fuel area" of Canada.

An Acute Fuel Area in Canada Largely Dependent on Imported Coal

This "acute fuel area" is now dependent for domestic requirements mainly upon Pennsylvania anthracite and for industrial needs upon Pennsylvania bituminous coals, as well as upon Canadian water power. So far as *domestic* heating requirements are concerned Mr. Dick, the Consulting Mining Engineer of the Conservation Commission, in his paper on the "Rational Development of Canadian Coal Resources" has pointed out the possibilities of the Western portion of the "acute fuel area" being furnished with briquetted lignite from the prairie provinces. Mr. Stansfield, of the Dominion Mines Branch, in his paper on "The Low Temperature Carbonization and Briquetting of Bituminous Coal" has pointed out the possibilities of meeting the domestic heating requirements of the Eastern portion of the "acute fuel area" by the product from the low temperature carbonization of Nova Scotia bituminous coals. Although both these processes are proven to be practicable,

CONSUMPTION	BRITISH COLUMBIA	ALBERTA	SASKATCHEWAN	MANITOBA	ONTARIO	QUEBEC	PRINCE EDWARD ID	NEW BRUNSWICK	NOVA SCOTIA	GRAND TOTALS
Domestic										
Anthracite	10 544 (2)	113 130 (2)	28197 (2)	1 658 (2)	-	—	—	—		
Bituminous	1 311 433 (2)	1951 833 (2)	140 413 (2)	17 719 (2)	—	994944 (1)	82924 (1)	891 031 (1)	2 826 300 (1)	
Lignites	21 143 (2)	959 526 (2)	1134 346 (2)	79 252 (2)	—	—	—	—	-	
Total Domestic	1 343 120	3024 489	1 302 956	98629	—	994944	82924	881,031	2826300	10 701 530
Imported										
Anthracite	—	Small	208 000 (3)	325 000 (3)	2 242 874 (3)	1794 410 (3)	—	Small	Small	
Bituminous	—	Small	718,879 (3)	1,627,998 (3)	6 459 105 (3)	4 174 850 (3)	—	—	—	
Total Imported	—	Small	926,879	1,952 998	8701 979	5969 260	—	Small	Small	17 580,603
Total Consumption	1 343,120	3024,489	2,229,835	2,051,627	8,701,979	6,964 204	82,924	891,031	2,826 300	28 282 133
Total Production	2,584,061	4,559,054	281 300	—	—	—	—	143 540	6,912 140	14 480,095
Production over consumption	1 240,941	1,534,565	—	—	—	—	—	—	4 085,840	
Consumption over production	—	—	1,948,535	—	—	—	—	747,491	—	
Consumption no production	—	—	—	2,051 627	8,701,979	6,964,204	82 924	—	—	
	BRITISH COLUMBIA	ALBERTA	SASKATCHEWAN	MANITOBA	ONTARIO	QUEBEC	PRINCE EDWARD ID	NEW BRUNSWICK	NOVA SCOTIA	

SOURCES OF DATA

This data obtained from

Alberta Dept of Public Works Annual Report [illegible]

Alberta Dept of Mines Quarterly Bulletin, [illegible]

British Columbia Bureau of Mines Annual Report, [illegible]

Canada Dept of Mines, Mines Branch, Production of Coal & Coke in Canada, 1916

Canada Dept of Customs Annual Report, [illegible]

New Brunswick Crown Land Dept Annual Report, [illegible]

Nova Scotia Dept of Public Works and Mines, Annual Report of the Mines 1915-16

U S Geological Survey The Coal Fields of the United States, [illegible] Professional Paper [illegible]

[illegible] Part A, Production Part B Distribution and Consumption, 1916

REMARKS

[illegible]

Tonnages (1) Are from Mines and other reports of provinces concerned
(2) Are from combinations of reports of provinces concerned
(3) Are calculated, allocating the tonnage according to population and known consumption [illegible] and domestic deductions and additions being made accordingly for domestic and imported tonnages in order to arrive at a reasonable figure. These figures cannot be obtained direct from any Government report

Differences in totals are accounted for partly by [illegible] arbitrary figures in some cases for purposes of calculation and by different methods of tabulation and statistics

PLATE No. 1—Note Acute Fuel Area.

they are as yet in their formative or agitational stage and some considerable time must elapse before they can be placed on a commercial basis to furnish sufficient fuel to substitute for any large portion of the Pennsylvania anthracite now imported for domestic heating. There is at the present time no available supply, even in small quantities of a Canadian coal fuel to take the place of imported anthracite. Nevertheless, this "acute fuel area" can eventually be made independent of foreign fuel imports and Canada can become self-sustaining, at any rate, in respect of her domestic heating requirements. There must, as a necessary preliminary, be a national, co-ordinated development and use of all the available fuel and power producing agencies in the Dominion. Such a co-ordination must be a matter of gradual evolution and adoption, and will, to a great extent hinge on whether Canada can reasonably expect assured fuel imports from the United States for a considerable period in the future.

Canada an Exporter of Electrical Energy

As we are now exporting large quantities of coals from British Columbia and Nova Scotia into adjacent States of the Union and as we are also exporting about 275,000 horse-power of electric energy, equal in value to about 5,000,000 tons of coal, it is obvious the United States cannot afford to place a sudden and complete embargo on coal exportation to Canada. The two countries must deal with each other, at least, upon a basis of quid pro quo. Providing Canada has her own fuel resources under strict national control, this power exportation should assure her an importation of sufficient coal to tide over any readjustment period necessary to permit of an ultimate dependence on Canadian sources of fuel and power.

Exportation of Electrical Energy and Assurance For Fuel Needs

The exportation in the past of Canadian electric energy has not been without compensating advantages. An assured United States market for Canadian power loads has enabled the financing and completion of several hydro-electric projects, the construction of which, so far as domestic markets alone are concerned, would not have been warranted at the time. The initial United States power load has, therefore, made it possible for the domestic market to reap all the benefits of available hydro-electric energy many years sooner than otherwise would have been possible.

While Canada has been receiving far more value in her coal importation than she has given in her power exportation the advantage is rapidly disappearing. It is reasonable to expect that the tendency will be for hydro-power exportation to increase and for coal importation to decrease. The time may come, and in the near future, when the balance will be against Canada.

It is, therefore, imperative that every proposal for increase in the exportation of power be carefully considered from a broad national standpoint. Such consideration involves the evolution of a formula with regard to power exportations which will have cognizance of Canada's fuel-power needs generally.

We must face the fact that for some time to come we shall require to import United States coal, and that in turn therefore we can, under proper conditions of recovery safely and profitably export some of our surplus hydro-electric energy.

Canada to Become Self-Sustaining must use all her Fuel-Power Resources According to their Particular Adaptability

Mr. B. F. Haanel, Chief of the Fuel Testing Division, Department of Mines, in his clear and comprehensive paper on the "Fuels of Canada", describes the nature, location and extent of our varied, available fuel resources. Mr. Haanel affirms that, while the problems associated with the distribution of fuel to the various parts of Canada are exceedingly complex and the strictest conservation must be practiced, the Dominion is endowed with fuel deposits on such a magnificent scale that all that is necessary is their proper exploitation and economic use of the country to be eventually practically independent of foreign sources of fuel. Mr. Haanel is particularly emphatic that Canada need not go abroad for fuel for household use, if her own fuel resources are properly exploited.

The problem of Canada's fuel needs outside of the "acute fuel area" offers little difficulty, owing to an abundance of both coal and water power. It is simply a matter of efficient and effective use of available resources. Within the "acute fuel area", however, the problem is pressing and prodigious. It resolves itself into two parts, first, provision for domestic or household heating consumption, second, provision for industrial requirements.

1.—*Domestic requirements of "Acute Fuel Area" involves production of suitable substitute for anthracite.*

Domestic needs involves the production of a fuel or fuels which will meet the requirements for general household use. At the present time this need is furnished by American anthracite, over 4,000,000 tons were used in 1916. Competent experts declare the anthracite coal fields of the United States are in measurable distance of exhaustion and that the supply will not last a hundred years. Having in mind the ever increasing demands within their own borders for this fuel and the rapid decrease in quality as the supply becomes exhausted, responsible fuel advisers of the United States Government have seriously urged the establishment of an embargo against exportation of anthracite. We in Canada must realize that our supply of this fuel may be gradually restricted. It is, therefore, essential that we, without delay, consider what can be accomplished in the production of a suitable substitute for United States anthracite.

II.—*Industrial Requirements of "Acute Fuel Area" involves:*

(a) More efficient use soft coal in central heating stations.

(b) Construction super-power plants to serve contiguous industrial areas.

(c) Substitution of hydro-power for steam produced power wherever possible.

(d) Use of hydro-power for all new industries wherever practicable.

The second part of the "acute fuel area" problem and the one with which water power is most intimately connected is the fuel necessity of the industrial or manufacturing world.

The *Industrial requirements* are now met by Canadian hydro-power and United States bituminous coal—about 14,000,000 tons consumed in 1916 for this purpose in the "acute fuel area".

Owing to the large reserves of bituminous coal in Pennsylvania, this class of fuel will probably be available to the "acute fuel area" of Canada for many years. Although not immediately necessary, the ultimate substitution of bituminous coals must, nevertheless, be seriously considered. Water Power will be the main means of such substitution. *The industrial fuel problem, therefore, in the "acute fuel area" becomes largely a matter of substitution of hydro-power for fuel power.*

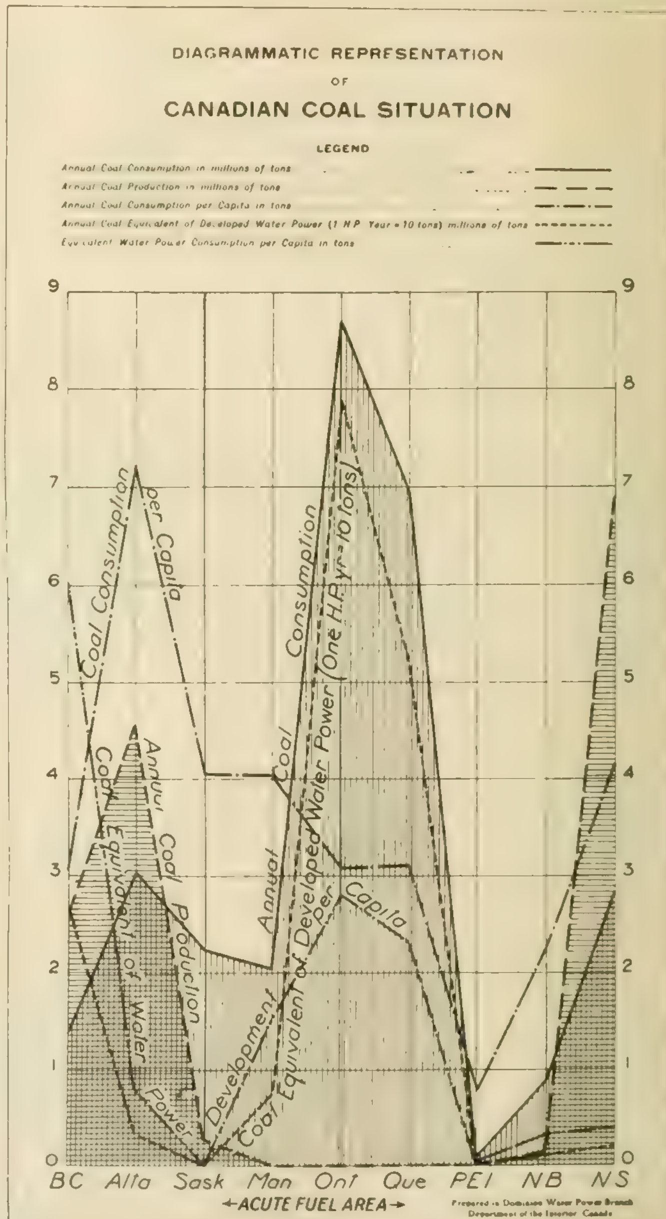


PLATE No. 2—Canadian coal situation.

Electrification of railways—especially terminals with adjacent engine divisions,—would save enormous consumption of bituminous coal and relieve our transportation systems of their greatest burden.

It is estimated that something like 9,000,000 tons of coal was consumed by our railroads in the year 1917. Judging from the results obtained from the electrical operation of railroads in the United States, it would be possible to save at least two-thirds of this coal if electric locomotives were substituted for the present steam locomotives. This would be a saving of 6,000,000 tons of coal in one year, and would require about 900,000 water horse-power.

Electrification of steam roads at this juncture is not advocated. Under normal conditions, however, and in certain districts, as in western Ontario electrification will become an economic necessity in a few years.

In districts that cannot be served by water power, the location of modern, efficient, super-power stations at strategic points, with a resultant elimination, or combination, of many inefficient small stations, would cause a very large saving in the consumption of soft coal, with a concurrent increased production of power.

The substitution in industry generally of hydro-power for steam fuel-power, would also result in a tremendous relief. There are many plants where such an exchange would be possible now. Future manufacturing plants should be encouraged to locate where hydro-power is available.

Water power must be depended upon very largely to serve the industrial fuel-power situation in the "acute fuel area" of Canada.

The relation between developed water power and the coal production and consumption in the various provinces is represented on Plate 2. It is interesting to note that in the "acute fuel area" there is about as much water power developed, as far as coal value is concerned, as there is coal consumed. It is portentous that the bulk of our water power production at the present time is within the "acute fuel area", and it is reassuring to know that our largest and most important potential water powers are located within transmission range of present congested industrial districts within the "acute fuel area".

Canada is Exceedingly Fortunate in the Extent and Location of her Water Powers

When considered in retrospect the production of hydro-power in Canada has undoubtedly been an industrial achievement and an engineering triumph worthy our nation. In the short space of about twenty-five years, there has been developed and put in use, nearly 1,800,000 water horse-power. A tabulated statement (see Plate No. 3) of the water power development in other countries, compiled recently from all available data, shows the universal importance of this resource and indicates the splendid comparative position Canada enjoys in both potential and developed water power. *The present per capita power development in Canada is larger than all other countries except Norway. It is the same with respect to our known undeveloped water power. No country enjoys to a greater degree the benefits of cheap dependable hydro-power, and no country has had these benefits more universally applied for municipal industrial and domestic use.* That Canada is recognized as one of the great water power countries in the world is due largely to,—

1st,—The nature and extent of our water resources—abundance and seasonable distribution of rainfall; the regimen of our rivers—upper waters well forested with large lakes, suitable for regulation—rivers flowing through valleys with well concentrated falls.

2nd,—The fortunate location of the waterfalls with respect to existing commercial centres, and related raw materials.

3rd,—The consistent endeavours of governments, Dominion and Provincial, in having water powers thoroughly investigated and intelligently administered.

4th,—The business acumen and foresight of the capitalist, and the professional skill and courage of the engineer, in blazing the trail of pioneer water power development and use.

5th,—The almost universal adaptation of electric energy for municipal, industrial and domestic purposes.

Fortunate Location of Water Powers

The outstanding feature of the water powers of Canada is their fortunate location with respect to existing commercial centres. Within economic transmission range of practically every important city from the Atlantic to the Pacific, except those in the Central Western Prairies there are clustered water

Country	Area Sq. miles.	Population latest available figures.	H.P. Available	H.P. Developed	Per cent utilized	H.P. Available per sq.mi.	H.P. Developed per sq.mi.	H.P. Per Capita Available	H.P. Per Capita Developed
U.S.A.	2,973,890	98,783,300	28,100,000	7,000,000	24.9	9.4	2.35	0.28	0.071
Canada "A"	2,000,000	8,033,500	18,803,000	1,735,000	9.2	9.4	0.87	2.34	0.216
Canada "B" Populated	927,800	8,000,000	8,094,000	1,725,000	21.3	8.7	1.86	1.01	0.216
Austria-Hungary	261,260	51,173,600	6,400,000	566,000	8.8	24.8	2.17	0.13	0.011
France	207,500	39,601,500	5,5?7,000	1,100,000	11.6	26.8	3.14	0.14	0.016
Norway	124,130	2,391,780	5,500,000	1,120,000	20.4	44.3	9.02	2.30	0.468
Spain	190,401	19,588,700	5,000,000	440,000	8.8	26.3	2.31	0.26	0.022
Sweden	172,960	5,522,400	4,500,000	704,500	15.6	26.0	4.08	0.81	0.127
Italy	91,400	26,001,600	4,000,000	976,300	24.4	43.8	10.7	0.14	0.034
Switzerland	15,976	3,781,500	2,000,000	511,000	25.5	125.2	32.0	0.53	0.135
Germany	208,800	64,926,000	1,425,000	618,100	43.4	6.8	2.96	0.02	0.010
Great Britain	88,729	40,831,400	963,000	80,000	8.3	10.9	0.91	0.02	0.002

"A" excludes Yukon and Northern Area improbable of immediate development. "B" included in "A" is area actually settled.

PLATE NO. 3—Water Powers in Europe and North America—Dominion Water Power Branch estimate, slightly revised.

power sites, which will meet the probable demands for hydro-power for generations. The following table, prepared by the Dominion Water Power Branch indicates, reasonably accurately, the provincial distribution of the developed and undeveloped water powers within the settled portions of the Dominion.

Province	Power Available	Power Developed
Ontario	5,800,000	789,466
Quebec	6,000,000	520,000
Nova Scotia	100,000	21,412
New Brunswick	300,000	13,390
P. E. I.	3,000	500
Manitoba		76,250
Saskatchewan	3,500,000 (Manitoba, Saskatchewan, Alberta)	100
Alberta		32,860
B. Columbia	3,000,000	269,620
Yukon	100,000	12,000
Total	18,803,000	1,735,598

Small Portion (Not 10%) of Canada's Available Water Powers Developed

In general, the use of water power in Canada may be briefly described as follows:—

(a) For municipal, including domestic and ordinary industrial purposes, about 78% of total developed or 1,348,490 H.P.

So far as these uses are concerned further requirements will probably be met for some years by additional installations at, and increased storage for existing plants. In certain centres, however, as for instance the Niagara power zone, growing requirements can only be met by new water power developments.

(b) Pulp and paper, about 14% of total developed or 248,075 H.P.

Further pulp and paper plant requirements can probably be met for sometime by additional installations to present plants, although the tremendous growth of this industry will necessitate the development of new water powers in different parts of the Dominion. There are now 54 pulp and paper plants scattered throughout Canada and several new plants have been under serious contemplation, some of which would be in use now had it not been for the difficulty of financing due to war conditions.

On account of the isolated nature of the industry—away from commercial centres—power requirements for pulp and paper need not conflict with other demands upon hydro-power.

(c) Electro-chemical and similar processes, about 8% of total developed or 140,000 H.P.

While the United States have achieved almost a world supremacy in electro-chemical, this industry in Canada is of very recent growth. It has, however, expanded at an enormous rate, entailing recent extensive additional installation in present plants, and requiring in the near future the development of additional water power sites. Our propinquity to the United States, and our abundance of essential raw material will compel the migration to the Dominion of many new electro-chemical plants of importance and value.

The products of the electro-chemical industry are extremely diversified. They include aluminum, silicon calcium-carbide, cyanimid, ferro-alloys, graphite carborundum, chlorine, etc., many of which are indispensable in the arts and in manufacture. Without aluminum the modern high-speed scout air plane would not exist; without electro-chemical abrasives and ferro-alloys manufacturing processes would be lengthened many fold. Our industrial supremacy in times of peace is dependent upon these products to a very considerable extent.

One of the most important electro-chemical processes is the fixation of nitrogen, about 30,000 H.P. is used for this purpose at Niagara by the American Cyanamid Company and, while other plants of this kind have so far not been put into operation commercially in this country, they have been seriously contemplated, and await only a sufficient source of low-price power for realization.

The electro-metallurgical industry is in its infancy, but promises great expansion, especially in the production of Nicu-steel in Canada. Few people appreciate the rapid growth during the last two years in the use of electric furnaces for the production of the highest grades of steel.

By proper foresight the demand for hydro-power for these industries, need not conflict with other demands, as for instance, municipal, domestic and ordinary industrial uses.

Total developed power about 1,735,598 H.P.

Further Use of Hydro-Electric Power

In considering the future of water power development in Canada, it is important to note that it means the use of a nonexpendible resource, and in many cases represents the substitution of an inexhaustible resource for an exhaustible one. For this reason, the use of hydro-electric energy should be encouraged in every reasonable way.

Futher development of water power in Canada will, undoubtedly, be extensive and must depend very largely on,—

(1) *Additional requirements for municipal, industrial and domestic use.*

(2) *Growth of pulp and paper industry.*

(3) *New electro-chemical and electro-metallurgical processes.*

(4) *Electrification of steam roads, especially terminals and adjacent engine divisions.*

(5) *Substitution of hydro-electric power for fuel-power in manufacturing and industry.*

In the rapid development within a short space of time of our water powers to the extent of nearly 1,800,000 horsepower, it is natural to expect that there has been some misconception in design, in construction, in conservation of opportunity, in overlapping of service, and even in Governmental administration, although as to the latter it is an axiom in British jurisprudence that "The King can do no wrong". If we were starting de novo to develop our water powers, with our present knowledge of what is essential in Government investigation and administration, of what is really basic in Conservation of resource, of the present practice of the art of hydraulic and electric engineering, and last, but by no means least, of what is the most important or prior market demand, from a national standpoint, from particular power sites, whether general municipal requirements should precede electro-chemical and allied industrial requirements, we would, for instance, most assuredly produce a very different power situation at Niagara. At the same time, this most important and world famous source of our electric energy has well served us. Generally speaking, our water powers have undoubtedly proven to be one of Canada's most valuable assets.

Looking to the future in power development, if Canada is to reap full benefit from her heritage in white coal, there must be a constructive liaison between

(a) the various Dominion and Provincial Government administrative Departments concerned in water power matters;

(b) the producing corporation or commission, and

(c) between the consuming public.

Concurrently with such a liaison there must also be an adequate co-ordination of the development and use of water power with that of all other power producing agencies.

Anyone, who has listened attentively to the very able presentation of the various elements in the fuel situation during the last two days, must realize that there is a prodigious field for such co-ordination in the development and use of our varied power and heat producing resources which will combine the effective use of all along lines for which each is best adapted, and which will, by avoiding duplication or misdirection of effort, promote the efficiency of both individual and conjoint use.

The necessity for the correlate development and use of all our fuel-power resources has surely passed the agitational or educational stage. The many urgent reasons for such correlated use are stressed a hundred-fold by the coal shortage experience of this winter.

To visualize the interdependence and interrelation of all the fuel-power agencies available in Canada, and to offer something as a basis for general discussion, I have prepared a chart (Plate No. 4), which if it indicates any one thing, it conclusively proves the immensity and complexity of the problems involved in effecting the co-ordinated, concomitant development and use of all our fuel-power resources. The chart shows that this can be best realized following the evolution of a national master fuel-power policy for all of Canada.

Gentlemen of the Canadian Society of Civil Engineers, are we going to leave this great problem in "the laps of the gods"? Is it not one of peculiar concern to engineers, and of such timely and pressing importance to Canada that we, as a Society, would be warranted in attempting a solution? Should we not mark the enlargement of the scope, influence and prestige of our Society, (which we hope is being exemplified by its transition to the Engineering Institute of Canada), by an earnest effort to evolve, in general terms, the basic principles of a national master fuel-power policy for Canada.

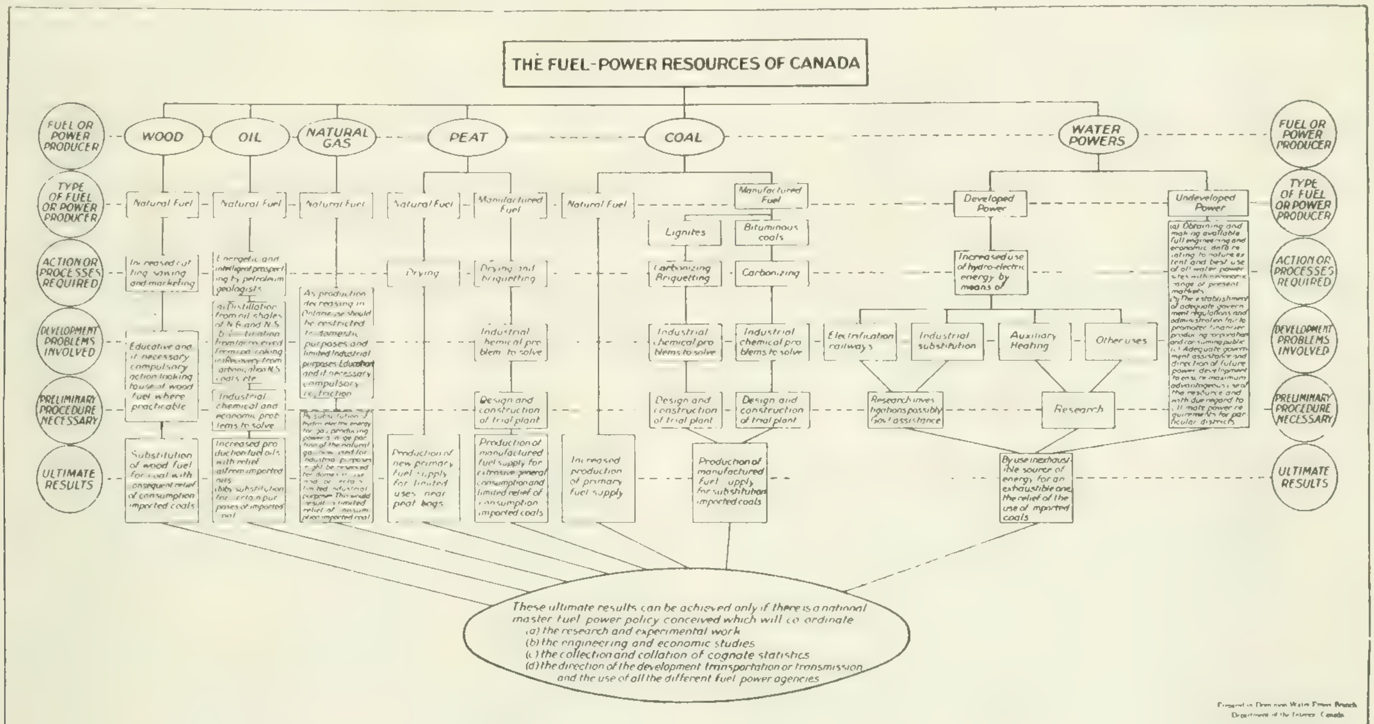


PLATE NO. 4—The fuel resources of Canada.

Cheap power promises to be one of this Country's greatest assets in the post-bellum industrial rivalry of nations for world trade. Our great fuel reserves, supported by our water power resources, represent a sure source of cheap power, and should guarantee Canada her share in world trade, if our varied fuel-power resources are availed of to their maximum possible advantage.

Mr. John Murphy, Member of Council, Can.Soc.C.E., Chief Electrical Engineer, Department of Railways and Canals, followed with the reading of his paper on

Railway Electrification

Note.—The writer wishes to acknowledge his indebtedness and to publicly return his thanks to Officials of the Railways below mentioned and of the Manufacturers of the apparatus referred to, as well as to the technical press from which much of the following material has been gleaned.

Still smarting from the sufferings of two successive winters' fuel shortages, caused by inadequate transportation facilities, we are foregathered to see what can and should be done to prevent, if possible, recurrences of such serious and trying experiences.

No argument is required, I think you will agree, to support the contention that eliminating the need for coal at a considerable distance from the mine *is* a greater measure of relief, and of true conservation, than increasing mine

production and thereby incidentally adding more load to the already overburdened railways. Reducing coal consumption automatically relieves or releases men and apparatus all along the route from the mine to the consumer —it also relieves the route itself from some of its congestion.

So eminent an authority as Mr. C. W. Rice, the President of the American Institute of Electrical Engineers, addressing that body in New York last month made the following statement:—

> "It is really terrifying to realize that 25% of the total amount of coal which we are digging from the earth is burned to operate our Steam Railroads—and burned under such inefficient conditions that an average of at least 6 pounds of coal is required per horse-power-hour of work performed. The same amount of coal burned in a modern Central Power Station would produce an equivalent of three times that amount of power in the motors of an Electric Locomotive, even including all the losses of generation and transmission from the Power Station to the Locomotive."

Mr. Rice went on to say that *150,000,000 tons* of coal, nearly 25% as he said, of all the coal mined in the United States, were consumed in Steam Locomotives last year.

Here in Canada Steam Locomotives also did their bit and consumed about 9,000,000 tons—30% of the 30,000,000 tons of coal imported into and mined in this country. Our 9,000,000 tons cover, I believe, wood and oil consumed on Steam Locomotives; some 49,000,000 gallons of oil are covered by the Canadian record. But in the United States figures 40,000,000 barrels of oil, 15% of the total output, are not included.

The conservation of—the elimination of the necessity for mining—those great quantities of fuel would be secured if all the Railways were operated electrically, and if the electrical energy were generated from water power. Modern Steam Central Stations would save from 50% to 66% of the coal now used in Steam Locomotives if the latter were discarded and Electric Locomotives used instead.

With such possibilities for Fuel Conservation in sight may we not soon expect to learn that the Fuel Controllers in both countries have asked the Railways, and that the Railway Managers have asked their Engineers:—"How many of these millions of tons of coal can you save—when will the good work begin?"

It is said our Fuel Shortages were due to a combination of bad weather and inadequate transportation. As we cannot control the *weather* our attention and efforts must be directed to the *transportation portion* of the difficulty. Railway Electrification will reduce coal consumption and haulage; it will also greatly improve traffic conditions; Electrification, therefore, seems to be the solution of the problem. Under these circumstances it may not be out of place to recite in general terms what Electrification has actually accomplished on some notable Railways.

Railroading in the mountains is the most strenuous kind of Railway work. The examples which I have chosen cover mountain sections. The Butte, Anaconda & Pacific Railroad, by Electrification, increased its ton-mileage 35% and at the same time decreased the number of trains, and their incidental expenses, 25%. The time per trip was decreased 27%. It is said their savings in the first year's operation, after Electrification, amounted to 20% of the total cost of Electrification. They buy power from Water Power Plants.

On the Norfolk & Western Railway power is obtained from their own Steam Station. Twelve Electric Locomotives have replaced 33 Mallets of the most modern and powerful type. The tonnage has been *increased* 50%. Electrification obviated the necessity for double tracking. The salvage value of the released Steam Engines was 45% of the cost of Electrification. Electric Locomotives make 8 times as many *miles*-per-train-minute-delay as the Steam Engines. Their terminal lay-overs average 45 minutes and they are double-crewed every 24 hours. Pusher Engine Crews have been reduced from 8 Steam to 4 Electric. Pusher Engines or Locomotives have been reduced from 7 Steam to 2 Electric. Steam Locomotives used to "fall down" in cold weather—the Electrics, always "stand up," are really more efficient, in cold weather. At the New York Railroad Club meeting last year their Electrical Engineers stated that "coal wharves, spark pits, water tanks and pumps as well as roundhouses and turntables have all disappeared from the Electric Zone. Our track capacity has been doubled. Our operating costs have been reduced. From an engineering, an operating and a financial viewpoint our electrification has been a success." Speaking of the value of the regenerative electric braking of their system he went on to say:—"The use of the air brake is practically eliminated, it is only used to stop trains; it is regrettable we are unable to put a dollars and cents value on this great asset; to appreciate it properly one must have had experience with the difficulties of handling 90 car trains with air." Another official referring to the same subject made the following statement:—"Trains of 103 cars are taken over the summit, 12 to 20 times every day, down the 2.4% grade *without ever touching the air.* We never broke a train in two or slid a wheel. It is done so nicely we wouldn't spill a drop of water out of a glass in the caboose."

The 440 route miles of the Chicago, Milwaukee & St. Paul Railway which have been electrified will soon be augmented by 450 miles more. Nearly 900 route miles and about 33% in addition for passing tracks, yards, industrial tracks and sidings will soon represent the extent of this great Railway Electrification. Among the advantages secured by this Railway on its Electric Sections are the following:—The cruising radius of each Electric Locomotive is twice that of the Steam Engine. Sub-divisional points, where freight crews and Steam Locomotives were formerly changed, have been abolished; the Passenger crews' runs are now 220 miles instead of 110. For Railway purposes these Stations do not now exist; 7 or 8 miles of track have been taken up; through freights do not leave the main line track at all; Shops and Roundhouses have disappeared along with their staffs, and one electrician replaces the whole old force. An Electric Locomotive has made 9,052 miles in one month. Although schedules have been reduced the Electrics have "made up" more than 2½ times as many minutes as Steam Engines—*time* which had been lost on other divisions; 29% of Electric Passenger trains made up time in this manner. On a mileage basis alone the operating costs of the Electrics are less than one half the Steam Engine costs. Freight traffic increased 40% shortly after Electrification—double-tracking would have been necessary to handle such increased business under Steam operation. An average increase of 22%, in freight tonnage per train, has taken place. One Electric handles about 3½ times as many ton-miles as a Steam Engine; the reduction in time in handling a ton-mile is 30%; faster and heavier trains have accomplished these results, the *number of trains* has not been increased. About 11½% of the energy used by the Railway is returned to the line in

the process of regenerative braking and this returned energy helps to haul other trains. While this is a very important item, and reduces the power bills, it is only regarded by the management as of secondary importance in comparison with the more safe and easy operation of trains on the grades and the elimination of former delays for changing brake shoes and repairs to brake rigging when operating with Steam Locomotives. The Electrics maintain their schedules much better than Steam Engines. In three months the Electrics only waited for the right of way 254 minutes, while the Steam Engines in a similar period waited 1910 minutes—or 7½ times as long. Extra cars on trains only delayed Electrics 1/9 of the time Steam trains were delayed for a similar reason. Cold weather delayed steam trains 445 minutes in the three months under discussion, but the Electrics were not delayed a minute; the latter are more efficient in cold weather. Many of the delayed Steam trains were double-headers—never more than one Electric is hitched to a Passenger train. An *entire suspension* of Freight service, due to Steam Engines losing their steaming capacity and freezing up was not an uncommon experience. Electrical Energy for the operation of these trains costs considerably less than coal. This latter statement is one of the most interesting in connection with the operation of the C. M. & St. P. Ry. and it is especially interesting because it was made more than one year ago.

The foregoing experiences of men who are actually operating large Railway Electrification projects show what the Electric Locomotive is doing every day. As the Vice-President of the last mentioned Railway said "Electrification has made us forget that there is a continental divide."

The limitations of the Steam Locomotive are due to the fact that it is a mobile Steam Power Plant of very limited capacity, it is compelled to carry its own supply of coal and water, and it is unable to take advantage of many of the economical refinements of the large modern Stationery Steam Plant. On the other hand the Electric Locomotive has no such limitations; it merely acts as a connecting link between efficient gigantic stationery Steam or Water Power Plants and the train to which it is connected. The Electrical World summed up the situation a short time ago when it said:—Why continue to haul millions of tons of coal, for and by uneconomical Steam Locomotives, all over the country, and thus add more loads to the already over-burdened railways, when the power which they need so badly can be much more economically and efficiently transmitted to Electric Locomotives over a wire the size of one's little finger?

The continual increasing cost of Coal and Fuel Oil will force Railway Managers to look more and more carefully into Railway Electrification. Estimates of a few years ago now need revision. Money may be hard to get but if, at times, fuel cannot be obtained at all some substitute must be obtained if normal life is to be continued in northern latitudes.

A representative of the National City Bank of New York, writing of the period after the war, referred to the stagnation which may ensue in all the great industries now engaged in war work as soon as peace is declared; the multitude of the people thus thrown out of work in addition to the men of the returning armies would create unbearable conditions unless suitable employment will have been arranged for them in advance; he referred to the economic advantages of Railway Electrification and was of opinion that this work might solve the whole question if soon taken up with vigor. The Minister of Public Works, Hon. F. B. Carvell, M.P., addressing the Ottawa Branch of our organization a couple of weeks ago, spoke of the necessity for conserving the energy of our Water powers—instead of letting *them* run to waste—so that this great store of energy might be employed in assisting to build up our own and to rebuild other countries when peace comes. How nicely these two ideas, Water Power Development and Railway Electrification, work together if properly carried out?

With the view of securing something really worthy of presentation to this important meeting I recently wrote an eminent Engineer, a man of International fame, and recognized as an authority on Railway Electrification, requesting him to tell me his own views upon this subject. A specialist's opinion, in my opinion, is always very valuable. Here is a short extract from his interesting reply. He said:—"*Generalization* is always dangerous, especially in connection with Electrification of Railways, where so many factors such as the physical location, character of loads, the power situation, etc., come in to affect the decision if applied locally." From his sober statement it may be seen that my correspondent is an Engineer—*not* a politician. He proceeded as follows: "... with present equipment-prices the cost is absolutely prohibitive." This opinion, let me point out, is in connection with the proposal to "Electrify Everything." Do not let it dampen our enthusiasm. Listen to this also and kindly keep *it* in mind; it is another extract from the address of Mr. C. W. Rice above referred to. He said:—" I think we can demonstrate that there is no "other Way known to us by which the railroad problem "facing the country can be as quickly and as cheaply solved "as by Electrification."

While the present Fuel Shortage Questions have made us look to Railway Electrification for relief I feel such projects on a large scale can only follow or go hand in hand with Power Plant Development and Co-Operative Operation of Power Plants. The location of a number of Plants at different points—large Water Power Plants and Auxiliary Steam Plants—so situated and inter-connected that a failure at one Plant, or the connections to it, will not jeopardize the others or completely cut off and isolate an important Railway District is, in my opinion, an essential feature in connection with any large Railway Electrification Project.

The *99 year* contract of the C. M. & St. P. Ry. is worthy of more than a moment's attention and consideration in this discussion. That Railway has a contract with a Power Company which has a series of Plants stretching across the country parallel to the Railway. The Railway owns its Sub-Stations and secondary lines but is not concerned with the high tension lines or Power Plants of the Power Company. A reasonable rate for power arranged between a willing purchaser and a willing seller—a contract in fact which each party knows the other will respect—is the basis and the real reason for that great Railway Electrification. Neither party questions the other's integrity or financial soundness. One delivers the Power it has undertaken to supply and the other uses it. The arrangement is ideal in its simplicity and entirely satisfactory to everybody concerned. It will, in my opinion, be necessary to have such attractive Power-Supply Situations as those outlined above, backed by abundant supplies of power, in order to foster and encourage early Railway Electrification work in this country.

Railway Electrification is, in my opinion, a very pressing Economic, Financial and Engineering Problem—a Problem worthy of the best attention of the most highly trained and experienced Specialists.

Mr. J. M. Robertson, M.Can.Soc.C.E., Director of Southern Canada Power Co., then read the third paper of the afternoon session on

The Possibilities of the Relief of Fuel Consumption in Canadian Industry by the Increased Use of Hydro-Electric Energy

The growing necessity for some comprehensive plan looking towards the more complete and efficient utilization of our power and fuel resources has been apparent for many years to those whose duties make them familiar with the tremendous wastage of materials which results from the lack of coordination in the use of the various basic materials with which our country is so richly endowed. That part of the public which has been buying and using coal more particularly for industrial purposes, has until recently not been generally impressed with the need of any change in its procedure, much less educated to the point where it realizes what change is necessary if repetitions of the expensive experiences of this last winter are to be avoided. Simple reduction in demand; the restriction of the use of such materials, thereby restricting the output of essential industries is obviously not the solution. The goal to be aimed at is development, present and future, and in order to secure this end we must make use of such materials as are necessary for the maintenance of our trade and commerce and the growth and development of our national life. Economic utilization of such resources, considering both present and future, would limit the present use of irreplacable materials even though they might be more cheaply and readily obtained under given conditions, and promote the use of other materials whose use conserves to a greater extent the assets of the community. The elements of cheapness and availibility of raw materials are large factors in determining the success or failure of any industrial enterprise and as such must be given due weight. We have been, however, and we are still too much inclined to accept these factors as excuses for taking the material nearest at hand which happens to be suitable for our purpose, and letting the future take care of itself. A little thought and investigation devoted to the development of possible substitutes, will frequently disclose methods by which an industry may utilize materials or processes, the use of which does not deplete the resources of the Company. Ideal conservation would provide for the maintenance of the industries of the world by the use of basic materials supplied from natural growth, so that the stock of raw material which constitutes the capital of the world, would not be reduced but would be handed down unimpaired from generation to generation. Such an ideal is obviously beyond our reach in the present state of development, but although we are still using up our capital at an alarming rate, the increasing realization of the need of care and the increasing efficiency of utilization which scientific advance is making possible, makes an optimistic outlook on the future seem more reasonable than might be considered warranted by a consideration of the special and temporary restrictive measures which have been applied to industry as a whole during the past few months. From these experiences it is apparent that the most essential elements in our industrial life at present are transportation, fuel and power, and to a large extent transportation means fuel, since the equipment required for transportation can neither be produced nor operated in the absence of an adequate supply of fuel, and fuel to a large extent means power, and only the substitution of power can any large decrease in our fuel consumption be brought about. It therefore follows that any modification of our past practice which will maintain and develop our industries, and at the same time reduce the consumption of fuels, will be an application of true conservation principles in more than one way, as, first, it will reduce the consumption of a material which once used cannot be replaced, and secondly, it will reduce the demand for transportation for such material and thirdly, it will leave for the use of some other industry a larger supply of raw material for which, for its purposes, there is no present substitute.

A few years ago the idea of practically achieving any real measure of co-operation between the coal and power producers and the consumer would have been thought visionary. The lessons in co-operation which we have been forced to learn as a result of the necessities of war, have, however, covered a much wider educational field than that to which they applied as war measures. The realization that we must fit ourselves industrially to take a leading position in the highly competitive world markets which will exist after the war is over, accentuates the demand for some national action which will provide a continuous, comprehensive plan to which all action can be co-ordinated, so that we will all be working toward the common good with due consideration for the right of others and not each for himself with no regard for others as has too often been the case in the past.

The general subject of substitution of hydro-electric energy for coal in industry falls naturally into two parts:

First—the replacement of coal presently used in existing factories for the production of power and the operation of processes requiring heat.

Second—the provision of means whereby in the future factories will be located with some regard for the basic facilities required for their operation, such as power, heat, transportation and raw material, in order that such plants may be so situated that they may be able to secure adequate supplies of these raw materials with a minimum of waste and loss in the transportation to them of basic materials and the delivery from them of their finished product.

In considering the first problem we are immediately faced with the general consideration of the use of fuel as a source of power.

The use of raw coal as a basis for the generation of power through the medium of steam is fundamentally uneconomic, as too large an amount of valuable by-product is sacrificed for very little return and the efficiency of the energy conversion is much too low to be satisfactory. When it is considered that under average conditions the amount of coal required to generate a H.P. hour is of the order of five or six pounds representing an efficiency from coal to power of only three or four per cent which generally speaking must be again divided by two before the energy is applied to the work it can be readily realized that our present methods of operation leave much room for improvement. In defence of the steam plant it may be claimed that such figures represent only the practice of the smaller plants and that in the large manufacturing centres power is supplied

from steam plants which operate much more efficiently. It is an exceptionally good plant which can average a K.W. hr. on 1½ lbs. of coal including all auxiliaries so that even under the best conditions we get an efficiency only about 15%. It is, of course, necessary to remember that such low efficiencies are principally due not to imperfections in the equipment itself but rather to the limitations imposed by thermal laws and until a method of converting fuel into readily available energy radically different from that in use at present has been discovered such losses cannot be eliminated.

These figures, unsatisfactory as they are, tell only half of the story. In using raw coal we are throwing away in a wasteful manner many valuable by-products which add but slightly to its value as a fuel but which when extracted have a value greater than the value of the coal itself. Many of these materials as has been emphasized by other speakers, are essential elements in our industrial life for which at present there are no substitutes.

Notwithstanding this very unsatisfactory showing the necessities of the present case require that some coal should be used for fuel in the absence of better means of providing readily available energy. It would seem, however, more or less elementary that the use of coal for such purposes should be restricted to cases where no substitute is available in order that when science places in our hands improved means of converting fuel into power, we shall not be in the unfortunate position of having squandered our resources and left ourselves without the means to take advantage of the improved processes then available.

Climatic conditions in this country owing to the northern location impose upon us a heavy burden every winter. Heat must be maintained in our houses and shops. At this stage of progress the only generally available means of heating is by fuel—coal, oil or gas—of which the former is by far the most important. We cannot avoid the use of coal for heating our factories, but we can see to it that as soon as practicable raw coal is not used for this purpose, and that what fuel is used is for heating purposes only wherever adequate substitutes for coal generated power are available. Too many of our industrial establishments are operated entirely by coal simply because the directing head likes the idea of "independence" and declines to consider the purchase of public service supply because he would then be "dependent on the Power Company". In places where hydro-electric service is available the power required by such establishments should be purchasible and generally is purchasible at rates and under conditions more favourable than the costs of operation by coal and with much less investment for plant. In the cases of factories located where such service is obtainable sufficient engine plant only should be installed to make possible the abstraction of the maximum amount of energy from the steam before it is used for heating, the idea being to operate steam plant only to the extent of the heat requirements utilizing the steam equipment as the reducing valve and increasing or decreasing the purchased power to such extent as may be required to offset the variation in the by-product power recovered from the steam required for heating or process work.

As the average manufacturing establishment in most parts of Canada requires more steam for heat than for power during the winter months and almost no steam during the summer months, and as the demand for electric energy for lighting purposes is much greater during the winter such an arrangement works to the advantage of both Company and Consumer as the combination makes possible the almost ideal utilization of the energy in the fuel during the winter and the capacity on the power system thus released becomes available to take care of the increased load which must be carried electrically. The diversity thus introduced into the power demand makes possible the fixing of a power rate which is attractive to the consumer and, at the same time, remunerative to the Power Company.

In some plants considerable ingenuity is displayed in so combining equipment for utilizing steam, electricity and compressed air or refrigeration with outside service so that no fuel whatever is burned, except for supplying heat, and every possible unit of energy is abstracted from the steam before it is so utilized. Variations in the coincident demand for air and electricity is compensated for by use of machinery driven by two sources of power involving very interesting cross conversions of energy.

The experience of those who have plants operating under these conditions is eminently satisfactory as they have secured the convenience of freedom from unnecessary heat and dirt during the summer, the advantage of a standby plant as protection against shut down—extremely low cost of power during the winter and a satisfactory power service available at all times when required.

The fact that such economies are usually realized in plants of considerable size is due principally to the fact that the large plants are directed by executives of broad views who realize that elimination of waste is desirable even though in any given case it may not at the moment result in a net saving of money.

Instances have arisen this year in which factories which operate by steam power in winter and purchase Hydro-Electric power during the summer months have anticipated the date for the commencement of this purchased service with the consent of the Service Company, and are reducing their coal consumption as weather permits, to the minimum absolutely necessary for heat and are paying to the Company for electric service to make up the deficiency in power recovery the net amount they would have paid for additional coal. The Company having power available is satisfied to accept this amount for temporary service from month to month without further obligation on the part of either party. Such co-operation while not yet very extensive is encouraging as evidence of broad mindedness on the part of all concerned and leads us to hope that further progress in co-operation would develop many other instances in which very real savings could be made to the advantage of the country as a whole.

The demand for power for the operation of our industries is rapidly increasing, as a comparison of the figures representing the use of power for industrial purposes per head of the population of North America will show:

For the year	1870	the consumption	was	.064	H.P. per head.
"	1880	"	"	.072	"
"	1890	"	"	.1	"
"	1900	"	"	.2	"
"	1910	"	"	.25	"
"	1917	"	about	.35	"

As an indication of the extent to which an enlightened policy under favorable conditions can carry the development of hydro-electric service in industrial communities, a comparison of the figures representing the consumption of electrical energy supplied from all sources in the more

important industrial centres in America is interesting. For the year 1916 the figures in K.W. hours per head of population were as follows:

New York	225
Philadelphia	250
Boston	350
Cleveland	400
Minneapolis	450
Pittsburg	500
Buffalo	585
Toronto	700
Montreal	783

The figures for 1917 are not yet available, but it is probable that Toronto and Montreal would show increases of about ten per cent. Toronto would thus be about 750 and Montreal about 800. The whole Province of Quebec was about 700 and it is probable that the Province of Ontario would show about the same figure.

The total power utilized industrially in the Montreal district is about 200,000 H.P. of which about 165,000 is supplied from hydro-electric sources, the balance by steam. If the city pumping plant and the plant of the Street Railway Company, both of which must soon be converted, are excluded, the total steam capacity now in regular operation in this territory would be only about 10,000 to 12,000 H.P., about 5 or 6% of the total power utilized. Even this small part of the demand would be reduced materially were it not for the fact that most of these plants are of a kind which produce large quantities of combustible waste which must be disposed of by burning, or are plants in which there is relatively large demand for high temperatures of steam for process work and relatively small demand for power.

When it is considered that the amount of coal required to replace the electrical energy supplied by these hydro-electric plants would be of the order of 1,750,000 tons per year an amount about equal to the total of the coal which was brought up the St. Lawrence to Montreal from the Maritime Provinces before the war, or approximately one third to one quarter of all the coal used in Canada for industrial purposes, or about one eighth of all the coal produced in Canada at present, it is clear that while much remains to be done, a very considerable commencement has been made.

It should be borne in mind that this is no isolated instance, what has been done here is being done to a greater or less extent in many other districts as is clear from the large and increasing load carried by the hydro-electric system of Ontario. Toronto's use of purchased electricity is almost equal to that of Montreal and both of them are quite remarkable for their very complete utilization of hydro-electric power.

The total development of water power in Canada is approximately 1,800,000 H.P., the reproduction of which by coal would probably require the annual use of about 10,000,000 tons, an amount about twice as great as all the coal now utilized for industrial power purposes.

Co-operation between the consumer and the supply company, with fair rates and conditions for service, and a reasonable willingness on the part of the consumer to adapt himself and his plant to new conditions imposed in the interests of the general community, even when such adaptation may perhaps entail the sacrifice of a little of his individual independence, will assist our Companies in improving and extending the excellent service they are now rendering and will benefit the country as a whole by reducing to a minimum the utilization of irreplaceable materials and extending and broadening the use of power supplied from inexhaustible natural sources.

The development and utilization of our water power resources is a measure of our economic advance in the scale of civilization, and the formulating of a broad and liberal policy which will ensure the keeping of such development in advance of the requirements of our industries and the administration of such an important national asset in the interests of the country as a whole, and not in the interests of particular individuals at the expense of the community is an urgent necessity.

The suggestion of a previous speaker that action should be taken looking toward the establishing of specific means of bringing about such an important innovation, is one which should appeal to this Society as eminently practical and timely, and it would appear that no other body is so well qualified to take the initiative in such a matter and to advance suggestions for the consideration and guidance of the Government, in shaping its future policy.

It is surely not too much to hope that in a country so richly endowed with natural power sites, distributed almost ideally from an industrial and economic standpoint, the time will come when practically all of the power required for our industrial life will be supplied from such sources, and we will be free from the reproach that because it is easy and obvious, we cheerfully squander our patrimony while we neglect to develop to the fullest extent the natural heritage with which a wise Providence has blessed us.

The final paper on the programme was read by the author, Mr. P. H. Mitchell, A.M.Can.Soc.C.E., Consulting Engineer, Toronto, being devoted to

The Possibilities of Lessening Fuel Consumption in Canada by the Adoption of Electrical Heating

The use of electricity in heating to lessen the fuel consumption can have very little material effect on the situation at the present moment, due mainly to the general economic limitation of available electric power and to the high cost of heating produced electrically as compared with the cost of heating by means of the common fuels.

In the future, and probably in the near future, electricity, from its possible cheapness, its possible sufficient available supply and further, in some districts, from its necessity due to insufficient supply of combustible fuels may assume a very important role in the heating field. It is only by electricity developed from water power that the sufficiently low cost may be attained to make electrical heating feasible.

Canada is blessed with an abundance of water power and in some districts with ample coal deposits. Nova Scotia coal is used in Nova Scotia, New Brunswick, Prince Edward Island and Quebec; Nicola Valley and Vancouver Island coals are used in British Columbia; Crowsnest, Lethbridge and Edmonton coals are used in Alberta and portions of Saskatchewan and Manitoba. Ontario, practically all of Manitoba and a small part of Quebec are dependent on

United States soft coal and United States anthracite is used over a slightly larger area.

In examining the map of Canada, having in mind the distribution of coal areas and water power areas, it is apparent that the districts not readily served with native coal are the districts most abundantly served with water powers. From Montreal westward to Manitoba, in the districts supplied by United States coal, the water powers are destined to be developed to their maximums to serve the industries and utilities of the future.

It does not need much imagination to look forward, say fifty years, a period which may be within the life time of a large number of us. What will be the fuel situation then? Will coal, as normally at present, be available in generous supply? Will the peat and oil sources be meeting any lack of coal? Statistics do not show a promise of this and in the meantime, if this is "Canada's Century" what is the prospect of population? An increase to 25,000,000 people by 1968, I am sure is a figure well within the expectation of all and Central Canada's share of this may be 15,000,000 all dwelling in the area now dependent on imported fuel.

Further, our fuel situation is so closely meshed with that of the United States that we must appreciate their viewpoint. Are two hundred millions of population in the United States in 1968 beyond a conservative estimate? Many think not, and with a fuel consumption advancing out of all proportion to increase of population an economic limit of fuels is in sight. The prospect may result in a most drastic administration of fuels applying these to heating purposes only leaving to hydro-electric power all mechanical, railroad and metallurgical operations in the endeavour to conserve the diminishing supply and even then such a radical curtailment will only push forward the day when the substitution for fuels must be made.

The fuels of today are wood, coal, natural gas, peat and oil. Of these wood and natural gas are limited for many reasons and peat is a fuel only by extreme necessity and as yet is not a commercially accepted probability.

It may be that some genius will conserve and redirect the vast heat transfers of nature to serve mankind but today in addition to the combustible fuels we can only add electricity to complete the list of sources of artificial heat.

In all discussions of electrical heating there is one outstanding basis and that is the thermal value of electricity. One kilowatt hour of electrical energy is equal to 3,413 British Thermal Units or one kilowatt hour of electricity energy is capable of raising the temperature of 3,413 pounds of water one degree Fahrenheit. This heating value may be compared with that of other heating sources and we find that fundamentally the ordinary heating mediums at existing prices are appreciably cheaper.

For instance in the comparison of anthracite coal, bituminous coal, peat, oil fuel and electricity we find:—

Anthracite Coal in a well built and well regulated domestic furnace is capable of being burned at about 55 per cent. efficiency. A good anthracite contains 13,000 B.T.U's per pound.

At $8.00 per ton:

One cent will purchase 18,000 British Thermal Units of heat.

Bituminous Coal when burned in a first class mechanically stoked boiler installation and distributed for heating purposes is capable of about 60 per cent. overall efficiency. A good bituminous coal contains 14,000 B.T.U's per pound.

At $3.50 per ton:

One cent will purchase 48,000 British Thermal Units of heat.

Peat, in briquet form, with low moisture content in a properly arranged furnace should produce heat available for heating at 60 per cent. efficiency on say 7,000 B.T.U's net available. The industry should be able to approach $4.00 per ton so that:

One cent would purchase 21,000 British Thermal Units of heat.

Fuel Oil may burn 65% overall efficiency. One pound of the oil obtainable in the local market contains about 18,000 B.T.U's.

At 7 cents per Imperial Gallon:

One cent will purchase 15,500 British Thermal Units of heat.

Electricity when supplied to well designed heating equipment is capable of utilization at 100 per cent. efficiency. One Kilowatt hour equals 3,413 B.T.U's.

With Electricity at One Cent per Kilowatt hour:

One Cent will purchase 3,413 British Thermal Units of heat.

Or with electricity purchased at power rates in Ottawa or Toronto, which would average throughout twelve months at eight-tenths of one cent per Kilowatt hour:

One Cent will purchase 4,240 British Thermal Units of heat.

Today fuels are more expensive than shown by the above prices which indicate conditions at more like normal times or what we may expect after the war is over. For instance in Toronto today anthracite will cost $10.00 per ton, bituminous coal $7.50 per ton and fuel oil 14 cents per Imperial gallon. The cost of electrical power has unlike almost every other nameable commodity had a downward tendency and today is generally appreciably lower than before the war.

To recapitulate so that comparison of heating costs may be facilitated, and also showing fuel costs as at present, we find:—

One Cent will purchase of useable heat,—

From Anthracite at $ 8.00 per ton.......	18,000	B.T.U's
" " 10.00 "	14,300	"
From Bituminous coal at $3.50 per ton..	48,000	"
" " 7.00 " ..	24,000	"
From Peat at $4.00 per ton..............	21,000	"
From Fuel Oil at 0.07 per gallon.........	15,500	"
" " .14 "	7,750	"
From Electricity at 0.01 per Kilowatt hr.	3,413	"
" " 0.008 " "	4,240	"

It must be borne in mind that these costs and efficiencies are based on producing heated rooms in buildings, such as dwellings, and that electricity is shown used at 100 per cent. efficiency assuming it directly applied to the room to be heated and not affected by the unapplied waste of the other heating systems in chimney, boiler and transmission losses.

Bituminous coal can only be used in heating plants of some magnitude and is not suitable for dwellings except

by distribution from a central steam plant. Heating by anthracite coal is the source to which electricity is to be compared.

It is obvious that the cost of fuel is not the only factor in the cost of heating but that the cost of heating equipment attendance at fires, disposal of ashes and even further the extra cost of basement for heating equipment, fuel storage and even the more or less chimneys required are appreciable items while fire insurance also plays a part. To go fully into all these items is quite beyond the scope of this paper but I would propose a well based assumption that while the equipment for electrical heating for houses is more expensive than, say, hot air equipment, the greater annual charges against capital cost and for repairs etc., are more than offset by the greater convenience in the handling of electricity as a heating source rather than coal.

Electricity to seriously enter the heating field must instead of costing one cent per kilowatt hour or one cent for 3,413 British Thermal Units, approach one fifth cent per Kilowatt hour or one cent for 17,065 Kilowatt hours when it can economically compare with heating by anthracite coal at a fuel coast of one cent for 18,000 B.T.U's.

Let us consider an electrical heating load in detail. Assume first that a house, two stories and basement with 600 square feet area on the ground floor requires as its maximum here in Toronto a demand of 12 Kilowatts. We would find that the use of this throughout the year would be approximately as follows, the load factor on the maximum demand of the year:

For two	Months,	12 Kilowatts	on average	80%	load factor
"	"	"	"	65%	"
"	"	"	"	45%	"
"	"	"	"	20%	"
For four	"	"	"	0	"

This means a load factor of 35% over the year or for eight months including summer a load factor of 16.25%. The general use of electricity for heating will involve a scale of millions of horse-power. With the present heating appliances available we cannot expect plants to be built and electricity to be generated for heating purposes only so we must consider whether we can expect the development of an elastic commercial load of such magnitude that over twelve months of the year a 65% load factor, the complement of the 35% heating load factor, can be obtained so as to provide for 24 hours per day and 365 days in the year a 100% load factor load.

It will possibly suffice to answer this by indicating one prospective industry the electric power demand of which alone may readily keep pace with the future use of electric heating, that is, the manufacture of nitrogen products for fertilizers. With the depletion of natural fertility artificial fertilizers will be demanded throughout Canada. Briefly, one horse-power year will produce fertilizer for 100 acres of cultivated wheat land so that 1,000,000 horse-power, on the 65% load factor available would produce fertilizer for 100,000 square miles. There is no question of our complete dependence on manufactured nitrates in the not far distant future and on a scale which involves millions of horse-power.

Or it may be that the demand for electrical heating will be such that this load will be of primary importance itself and the future form of heating equipment by which electrical heating will be accomplished may be of necessity radically different from the present day devices to meet the requirements. Economical heating apparatus will undoubtedly be of the heat storing type so as to take advantage of the power available on the off-peak periods; these may use masses of high specific heat materials or even steam reservoirs in which to store and liberate heat over a 24 hour cycle and further the twenty-four hour use of electricity may be arranged to meet only the average conditions the surplus available during below-average periods being used for the manufacture of fuels, such as hydrogen, to be stored for use in the above-average periods thus providing a continuous electrical heating load over a yearly cycle.

The combination of the maximum developments of many of our great power sites should, when the non-heating load period has been organized to use power along other lines, or when a continuous heating load on a yearly cycle is established, readily make power available for electric heating purposes at an equivalent cost of less than $12.00 per horse-power year delivered in districts even remote from the generating source. Then the rate for heating purposes would be below .2 cents per Kilowatt hour or one cent would purchase over 18,000 British Thermal Units of applied heat. Electricity then if available in the necessary quantities would readily become the foremost source of artificial heat.

The use of electricity for many of the other domestic uses for heat such as for cooking, water heating, etc., is well established and forms no mean portion of the present electrical loads.

Now when we speak of millions of horse-power and our possible future dependence on a general use of electrical heating in Central Canada are we justified in anticipating that such enormous quantities of power will be available?

The latest comprehensive compilation of water power resources in Canada gives a total of about 18,000,000 horse-power available in the 2,000,000 of the 3,729,700 square miles of Canada's area which may be expected to be fairly thickly populated within the next few decades. It is stipulated for this figure that it is "inclusive in the case of Niagara Falls, Fort Frances and the St. Mary's River at Sault Ste Marie, of only the development permitted by international treaties, and further does not contemplate the full possibilities of storage for the improvement of capacities." The effect of such a restriction in the compilation of the totals of the water power resources may be indicated by the available power on the Canadian side at Niagara Falls when developed to a maximum being over 2,000,000 horse-power, while less than 500,000 horse-power is permitted by agreements the restrictions being practically dictated by the desire to retain the scenic beauty of the falls. Again practically all the water powers of Ontario on the Great Lakes and James Bay sides of the height of land are quite dependent on storage so that instead of some 5,500,000 horse-power being listed as Ontario's portion 12,000,000 here alone would more likely represent the possible development that the future may see, and it may be that instead of 17,820,000 horse-power in the southerly half of Canada 35,000,000 horse-power may be produced.

The present enormous use of electric power really had its inception 25 years ago when electric power was first transmitted from Niagara Falls, New York, to Buffalo while in Canada, in the last twelve years, the demand has jumped from about zero to the astounding figures of the present. Today, while there are 409,000 horse-power generated at Niagara Falls there is a serious power shortage and the power users are feverishly awaiting further developments of hundreds of thousands of horse-power at this source. If since 1905 and more particularly just within the last few years the power demand has grown so rapidly what will fifty years from now see? Possibly it will then be a scarcity

of sites to develop and all may be interconnected into a vast network of transmission and distributing lines all the sources combining to obtain the maximum of energy from the widely distributed water falls.

In conclusion I would briefly summarize as follows:—

1. Electric heating is not a present economic possibility due to high cost and lack of available power;

2. Electric power rates would have to be one-quarter of the present rates for electric heating to compete with heating by anthracite coal.

3. Many millions of horse-power would be required to meet even present requirements. For example, I would estimate a demand of 2,000,000 horse-power to heat Toronto's dwellings and other buildings, or 4 horse-power per person of population.

4. When millions of horse-power in Canada are developed and say, delivered $12.00 power is attained, a large electric heating load may be established. This, of course, does not mean that every portion of the country could be served but areas representing the great bulk of the population would be in the zones of distribution from such powers and it might thus be possible to greatly substitute for coal and other fuels.

5. It may be that the economic future of our fuel and water power resources will demand that in their administration fuels will be reserved for heating purposes and that the hydro-electric power available will be substituted to the maximum for all mechanical railroad and metallurgical operations.

6. By the use of devices for heat storing and fuel manufacturing in combined or separate installations so as to use throughout the yearly cycle a continuous heating load of 100% load factor but of average rather than of peak demand, electric heating might be given a positively economic status, or further by the development of loads in millions of horse-power equalling in demand the electric power required for heating, yet elastic enough in its use to adapt to the low load periods of heating, may again suffice to make electrical heating of economic importance.

Discussion on Water Powers and the Use of Hydro-Electric Energy

The discussion on the papers read in the afternoon was opened by Mr. H. G. Acres, M.Can.Soc.C.E., Hydraulic Engineer, Hydro-Electric Power Commission of Ontario, who remarked that the papers just read covered such a vast field and furnished such limitless opportunities for discussion and conjecture that it was impossible to touch upon more than one or two of the many points worth enlarging upon. He referred first to a matter alluded to by Mr. Challies and dealt with at length by Mr. Mitchell, stating that it might be interesting to enlarge upon some of the conclusions of the latter with special reference to the problem of heating the City of Toronto with Niagara power. In this connection Mr. Acres said:

First, as to cost—What fundamental conditions accounts for the fact that a house in Toronto can be more cheaply heated by means of Pennsylvania coal than by Niagara Power, supplied at actual cost? To work this out let us first take one kw. of potential heat from the falling waters of Niagara. Under peak load conditions, there will be 85% of this unit of heat left when it has passed through the turbine; 80% when it has passed through the generator; 76% when it has passed through the step-up transformers; possibly not more than 66% when it has passed over the transmission line; 62% when it has passed through the step-down transformer; 57% when it has passed through the local distribution system and 52% when it has passed through the service transformer. In other words about one half of this unit of heat would be left for effective use as heat on the premises of the consumer.

Then take a pound of coal from a Pennsylvania mine—the whole of this pound is delivered to the consumer's premises. It contains about 2 kw. hours of effective potential heat foe which you pay ½ cent on the basis of present price of coal, or ¼ cent for 1 kw. hour, as against 9-10ths of a cent for the kw. hour of heat from Niagara, on the basis of present rates.

This kilowatt of potential heat from Niagara undergoes six distinct steps of conversion before it is delivered on the consumer's premises as heat. The potential heat of the Pennsylvania coal undergoes one conversion only before being put to its ultimate use. The efficiency of conversion from the natural state to ultimate use is probably about the same, but in one case you require a power plant, a step-up transformer; 80 miles of transmission line; a step-down transformer; a distribution system and a service transformer. In the other you require a $200 furnace and a 50 cent shovel. These two conditions relative to the delivery of the commodity must be considered as having a more or less fixed influence on comparative costs, and the only factors which will tend to any appreciable extent to reconcile the present disparsity will be an enormous increase in the price of coal, or a compensating reduction in the cost of electric power, assuming, of course, that both commodities will be available for the use under discussion, which is another question altogether.

Then as to service conditions—I think there are about 80,000 buildings in the city of Toronto. It is safe to say that during the extreme weather last winter coal was being burnt in these buildings, for a day or two at a time, at an average rate of 4 tons per month, or say for a 2-day period, on several occasions, an average of 270 pounds of coal was burnt in each building in the city. I think that is well on the conservative side. On the basis of this assumption it would require over 1,500,000 horse-power of station capacity at Niagara to heat Toronto in zero weather. Furthermore, on the basis of Mr. Mitchell's estimates of load factor, for 2 months only 65 per cent. of this power would be used, for 2 months only 45 per cent, for 2 months only 20 per cent., and for 4 months none would be used at all. This is a service condition which is absolutely unheard of at the present time. Under such circumstances an extraordinary operating condition would obtain, in that the load-factor on the generating plant would be mainly controlled by the direction of the wind. On several occasions last winter the rise in temperature due to changing wind direction might have pulled half a million kw. off the station busses over night. Mr. Mitchell has suggested a solution of this load factor problem as far as the generating plant is concerned, but even granting that industries could be established at Niagara which could economically absorb these enormous quantities of off-peak power, it would not help Toronto with over 1,000,000 h.p. of installed transformer capacity operating at 35 per cent load factor, together with the necessary transmission line capacity to Niagara Falls.

In submitting these very approximate figures, I have, of course, not considered the matter of off-peak power. If the price of coal holds at the present figures, or tends to

increase, there is undoubtedly a commercial possibility of using electric power as an auxiliary heating medium during off-peak hours and a rate for this class of service could possibly be fixed sufficiently low to attract some consumers. This phase of the question cannot, however, be discussed very intelligently except at considerable length and on an essentially technical basis.

I may say here that the hypothetical service condition I have just described is one which is certain to obtain in the future at Niagara and at other large hydro-electric power centres, though in a much less acute form. The time is not far distant when the scarcity of power in what Mr. Challies has called the "acute fuel area" will revolutionize the present conditions and rules of service, and a certain class of consumers will develop who will be glad enough to make use, not only of all available off-peak power, but also to take advantage of such power as may be intermittently available during higher stages of flow. Those having to do with the development of hydro-electric power should, therefore, bear in mind that it is only a question of time when the scarcity of fuel and the approaching ultimate exhaustion of hydraulic power resources will make the produciton of intermittent power not only profitable, but necessary for the public welfare, and permanent works at least should be designed against such a contingency.

Now referring again to Mr. Challies' paper, the most important and significant section of the same is that which considers the use of Canada's fuel-power resources according to their adaptability. In considering this phase of the problem we are rather on the horns of a dilemma. Should we consider the advisability or possibility of moving out of the "acute fuel area" such industries as are mainly dependent on coal as a raw material or as a source of power, and of replacing them by industries mainly dependent on water-generated power, or should we look after these industries as best we can by centralized heating plants and out of our future allotments of imported coal? In other words should the problem of adaptability be attacked on the basis of adapting our fuel-power resources to industry as now existing and located, or on the basis of adapting industry to our fuel-power resources?

I have in mind one instance which will serve me as an illustration of the working of the latter alternative, that is, adapting an industry to our fuel-power resources. Cyanamid, calcium carbide and carborundum are made by processes requiring large quantities of cheap power. They also require large quantities of carbonaceous material which is now supplied in the form of coke made from Pennsylvania coal. There are two points to be considered in connection with this proposition, the most evident being, of course, the necessity of importing coal for such of these industries as are located in the "acute fuel are". The other point is that the uncontrolled expansion of such industries as these in the vicinity of our large boundary water powers will in the near future absorb capacity that at a slightly more remote period may be urgently needed to keep alive a multiplicity of small industries scattered throughout the territory which is within transmission distance of these sources of power. The unlimited development of large local industries in the vicinity of our large boundary waterpowers is, therefore, a possible condition of the future which would seem to be undesirable. As against the possibility of such a situation developing in the "acute fuel area" we have, for instance, the Nelson River, a virgin field for hydraulic power exploitation furnishing unrivalled opportunity for the appropriate and efficient location of industry. Three million horse-power of commercially utilizable energy, all more or less accessible to the Hudson Bay Railway and lying on the very threshold of the Empire's granary. Two million horse-power of this capacity would supply sufficient fertilizer for the whole of the northwest wheat area. Nitrogen and limestone are locally available and the only important ingredient lacking is carbon. Whether this lack can be made good by western lignite I do not know. That is part of the problem. Crow's Nest coal and Welsh coal, via Port Nelson, would, of course, be available at a price. Here is a problem which is directly in line with the all important issue under discussion at this meeting, and one which, if intensively studied, would at least serve the purpose of establishing certain fundamental laws which should govern the use of our fuel-power resources in relation to their peculiar adaptability. A co-related phase of this study would be to ascertain to what degree the use of the water powers in the "acute fuel area," more particularly the boundary water powers, should be controlled so as to preserve an equitable balance between the amounts of power allotted to large local electro-chemical and electro-thermal industries and the amounts of power required, or likely to be required, for general distribution purposes. As a general rule the industrial centres immediately adjacent to the developed power sites will be the first to benefit, but the inevitable result of industrial expansion will be to include more and more of the surrounding territory within the zones of influence of these sources of power, and it is supremely important that these zones shall expand freely along economic lines and not be forced into unnatural channels by private interest or other influences which should have no prior status in the control of a national asset of such magnitude as our water powers.

Now, before closing, I would like to mention another matter more or less directly related to the issue under discussion and which has been briefly referred to by Mr. Mitchell. Probably 90 per cent of the civilized inhabitants of this planet know Niagara only as a scenic spectacle. Most of them have nevertheless felt the commercial influence of Niagara without realizing it. Their first-hand knowledge of the world's most important water power has, however, been derived chiefly from picture post cards. Since power was first developed at Niagara Falls a continuous campaign of opposition to the commercial exploitation of Niagara has been carried on, based on aesthetic grounds. This opposition has left its mark on legislation on both sides of the line and on the Boundary Waters Treaty. As a matter of fact it is largely responsible for the present shortage of power.

The term "commercial exploitation" may sound cold blooded, but we may as well call a spade a spade, and anyway, in my opinion, the true glory of Niagara lies not in the roar and the rainbows, but in the vast potentiality of the falling waters, considered in the light of an instrument placed in our hands by a Divine Providence for a beneficent purpose, or, as Sir Adam Beck expressed it 8 years ago, "to raise the scale of living of our citizens, and to multiply and cheapen the comforts of life." Niagara can have no greater industry than this, and while aesthetic opposition to the commercial exploitation of Niagara must ultimately fade in the face of these more pressing issues, I think the process should be accelerated as much as possible. I have gone into this matter here because the members of the Canadian Society are qualified by training and vision to propagate this doctrine and let the world at large know what it means. The influence of the Society as a whole would also be a powerful factor in swaying sentiment in the right direction.

Finally, I may say that the papers we have listened to have served to confirm the fact that a world-wide field of commercial enterprise has been opened up which is pregnant with enormous possibilities, and the far reaching ramifications of its development will work an economic revolution more beneficent in its results than that which took place during the age of steam. I use the term "commercial enterprise" not merely in connection with the exploitation and development of hydro-electric power, but with a much wider meaning, embracing the use of power so derived for the support of a multitude of old and new industries, the production of cheap, sanitary light and heat, and the cheapening of universal necessities, not so much as a result of the cheapness of hydraulic power, but from the fact that power can be made available in such vast quantities as to insure an equally vast increase in the volume of industrial production.

It is not difficult for those here today to foresee the commanding position which Canada will occupy in the eyes of the world through the properly controlled and regulated development of her water-power resources and to realize that in the vast potentiality of her boundary streams, and in the equally great, but more widely distributed water powers of her inland rivers, Canada possesses an asset more enduring than the wealth of her mines and forests, or the fertility of her fields, and one which in the end is destined to become the corner stone of an industrial edifice, in the building of which this Society must by right take a leading part.

The Chairman.—"Dr. T. Kennard Thomson, a former citizen of this Dominion has, with his usual loyalty to Canadian enterprise, come up from New York to attend this meeting and perhaps he would consent to say a few words.

The Lower Niagara River Development

By T. K. Thomson

The hydro-electric development of the Niagara River should be taken up at once in a comprehensive manner as an International plan.

Otherwise, many individuals on both sides of the line will endeavor to obtain conflicting concessions in which the greatest good to the country could never be attained, and which, as will be shown, would probably result in disaster.

For instance, it is seriously proposed on the American side that at least 50 per cent of the water now going over the Falls should be diverted through canals or tunnels and returned to the river below the Rapids. Such a procedure would be the ruination of every power plant in the river as there would not be enough water passing through the Gorge to carry the ice over the rocks.

A withdrawal of even 10 per cent or less water might cause an ice jam that would destroy everything in the river below the Falls.

If any proof of this is needed it is only necessary to remember the ice jam of 9 years ago which lasted 8 hours: and also to remember that in the far past something, undoubtedly an ice jam, caused the Niagara River to leave its old channel at the Whirlpool, turn a right angle, and hew out a new channel from bed rock.

But even if there were no ice question a layman can see the absurdity of building canals, seven miles long, on top of the banks of the Niagara, 300 feet above the present water line, to carry one half the flow of the river.

To avoid a theoretical discussion, you all remember the canal of the Hydraulic Power Company at Niagara Falls, which is 100 feet wide by 14 feet deep and, mill race as it is, only accounts for 9,500 cu. feet of water per second. Well, to take half the flow of the River through new canals would require the equivalent of about seven of such as these on each side of the River, or, say, a channel 500 x 14 feet on each side. Moreover, any water diverted from above the Falls should be returned to the river just below the Falls, and the lower river should be treated by itself.

As the Speaker was born on one side of this river and christened on the other; also eight years ago evolved the plan for damming the lower Niagara River he hopes that he will be pardoned for being an interested party.

Our plan is to build a dam at Foster's Flats to take advantage of the 102 foot drop in the river between the base of the old Falls and Queenston, and to develop the 220,000 cu. feet of water per second, or nearly 2,000,000 horse-power; thus saving over 12,000,000 tons of coal a year.

We want to spend $100,000,000 on this great development without asking Canada for a cent; to give Canada half the power if she wants it; and the right to acquire half of the development whenever she wants to do so.

This can all be done in two years.

It is estimated that such an undertaking would easily attract outside capital to the extent of 20 times the cost of our plant.

As the consensus of sound judgment is in favor of this plan procrastination at this critical time would be an International calamity.

Discussion from British Columbia

By Edgar C. Thrupp, Kamloops

In view of the fact that the United States coal supply is expected to be exhausted within the present century and their oil supply within 25 years, it is obvious that they cannot be expected to supply Canada much longer, even after the war, and therefore, it is only prudent for us to prepare for the final withdrawal of those supplies. The occasion naturally raises the question of the advisability of electrifying our railways, and choosing the most suitable alternative fuel for other heating purposes.

The financial burdens during war time seem to be too serious to permit railway electrification to be undertaken during the war and therefore the new alternative fuel must serve the railways also in the central Provinces.

Labour shortage, particularly experienced mine labour, requires that the new fuel should be obtained as far as possible with unskilled labour.

Car shortage requires that the fuel should be obtained as near as possible to the points of demand. The lignites of Saskatchewan and Alberta in briquette form are the most natural sources of supply for the railways and for domestic fuel on the prairies, and the peat bogs of Ontario and Quebec for the domestic supplies of those provinces. Shortage of mine props and awkward materials in the roofs of the lignite mines will render the employment of unskilled miners undesirable and therefore during the war time a very large increase in output will be difficult, and for these reasons the peat bogs afford better opportunities for rapid output. The fact that they are all surface works is also in their favour for emergency output. Efforts should be made therefore to organize labour from the cities of Quebec

and Ontario in sufficient numbers to turn out millions of tons of peat fuel this year. Much has been written about the desirability of recovering the Sulphate of Ammonia from peat and lignite for sale as fertilizer at $65 per ton or more. This is a point on which I wish to express an adverse opinion so far as the present emergency is concerned. In my judgment it would be waste of money and time to employ any of the present available labour on the erection of the by-product plants and in any event the price of the fertilizer is bound to drop in a few years time to less than $40 per ton in competition with atmospheric nitrates produced by other processes, so the by-product plants should only be built later on, and subject to the clear understanding that they must be made to pay at about $35 per ton.

Prior to the war the atmospheric nitrate business had reached a stage of efficiency which would warrant the construction of hydro-electric plants in Canada of several hundred thousand horse-power for this purpose, using the fertilizer mainly for beets, mangels and potatoes, and it was good enough to apply to wheat if the farmers could get 90 cents or $1.00 per bushel for the grain. The present world crisis has rendered it quite possible that wheat will remain permanently at or above those figures, and it has also rendered it important that sugar beets and mangels should be grown in much larger quantities for making sugar and feeding live stock. The prospects for nitrate fertilizers are therefore considerably improved as regards probable demand, and improvements in the processes are also being made.

There is in some quarters a belief that the new Haber process may also be in the field. If it should prove to be commercially feasible on a very large scale, that is another reason for not embarking on sulphate of ammonia plants in the hope of getting $65 per ton. I am inclined to believe, however, that there is room for the Haber process and the Electrical Processes and the Sulphate plants also in the near future, in fact immediately after the war.

The Electric systems could supply all the needs of Canada for nitrates at a price which would prove more attractive to the farmers than the usual Agricultural College Advice about relying entirely on clover and alfalfa for nitrogen.

Possibly four or five million horse-power would be needed for this purpose and if another 500,000 or 750,000 H.P. is added for railway electrification and several million for metallurgical and industrial purposes, there may be in the near future a demand for 7 or 8 million H.P. for serving Canada alone.

Add to that 5 million H.P. for fertilizer to be exported from B.C. to Australia and 5 million H.P. for exports to the United States and Europe and it appears that between 15 and 20 million H.P. may be demanded soon.

Estimates have been put forward from time to time purporting to give the total available power in Canada at some 17 million H.P. I would undertake to show that British Columbia alone could beat that total if the problem is faced properly by full utilization of water storage facilities, and at a cost for the first 10 million H.P. considerably below the average cost per H.P. of existing plants of 20,000 to 40,000 H.P.

Our Government and Conservation Commission Officials appear to me to have taken a very timid and shortsighted view of the water power possibilities of this country, and I think the members of our Society might try to get broader views instilled into the minds of those who are supposed to be guiding the Governments.

To make Canada prosperous and progressive during the coming years while we are paying off our war debts, it is essential that there should be a large increase of production. That can be best accomplished so far as agriculture is concerned, by providing for commercial fertilizers to increase the output per acre in a much greater ratio than the increase in labour costs.

It can be best accomplished so far as industries are concerned by providing abundance of electrical power at the lowest possible cost.

The electrical power for railways can be best provided for by taking power from plants where 200,000 to 400,000 H.P. is generated at one dam.

England is losing $500,000,000 per annum by having electric power generated at hundreds of small plants, and it is proposed to save that sum by building 16 plants to handle the whole job. Why should Canada go on doing what has proved so unprofitable in England?

Ice troubles should not be allowed to scare us from tackling such places as Niagara rapids or the Nelson River to the limit. The remedy is clearly to construct ice fenders at the outlets of the lakes to prevent floating ice getting into the rivers. The fender at Niagara may be a simple pile structure perhaps two mile long.

All international boundary arguments about navigation and exporting power could be cleared up if it is recognized that the St. Lawrence navigation and power questions would both be easier to solve if dams are built across the river instead of wasting money on half-way jobs like the Cedars Rapids dam.

The best way to prevent an industrial slump after the war is to adopt a comprehensive scheme of development on some such lines as the following:—

1. Initiate Provincial schemes for the storage of water for power purposes to serve the largest power plants first, leaving small developments at higher costs for the future.

2. Offer some of these power sites with a guaranteed minimum flow of water for industrial purposes at a rental of $1 to $2 per H.P. per annum.

3. Electrify all railways in Canada on a standard system.

4. Nationalize the C.P.R. to bring it into line with the rest.

5. Construct all the power plants and railway electrical equipment with machinery made in Canada.

Such a programme would provide work for many of our factories for years to come, would improve the agricultural conditions to such an extent that it will be easier to get men to settle on the land, and will enable the country to dispense with imported fuel.

The Canadian Society of Civil Engineers might very well urge the Dominion and Provincial Governments to take the initial steps to prepare during the war time for carrying out the programme as rapidly as possible when the war ends.

The prospects of large revenues to the Provincial Governments from new sources should be sufficient incentive to induce them to start on the preliminary work for plans of the necessary water storage reservoirs.

Views of Members Present

Mr. Jas. White stated that in respect of the achievements of the past he would like to point out that different companies had attempted to exploit all the water powers in Northern Ontario and Manitoba but that the Charters applied for had been withdrawn because of educative opposition so that today such a Charter was an absolute impossibility. Mr. A. V. White commented on the utilization of hydro-electric energy, particularly regarding the wrong impression in the minds of the public regarding its use for heating purposes. In Toronto, with about 80,000 homes using on an average of ten tons of anthracite per year, it required approximately 800,000 tons for domestic heating purposes. To replace this would be required a million and a half electrical horse-power and another million would be necessary to replace an additional half million tons of bituminous coal used for heating, making a total of two million five hundred thousand electrical horse-power required to heat the City of Toronto alone. At present there is developed in the whole of Canada about 1,800,000 electrical horse-power which would not replace the fuel requirements for the City of Toronto alone. Mr. H. R. Safford, Member of Council, Can.Soc.C.E., commented favorably on the paper presented by Mr. Murphy. Regarding the application of electric power to steam roads it was always a local question and it was dangerous to deal in generalities when discussing a question of this kind. In most cases railway electrification was adopted for different reasons. The electrification of the New York Central in New York was largely a matter of civic betterment; coal with it was a question of inconvenient and dangerous operation through tunnel. The electrification of the Chicago-Milwaukee and St. Paul was the case of an entirely new railway in new country without any equipment already bought and operated by steam. The case of the Norfolk and Western was a case of electrifying some lines which produced a large amount of coal; it was a collecting proposition; the mileage involved was not great. And so it is with most of these other cases. "And the point I want to emphasize is that we should not be lead, as it is very easy for us to be, into discussing electrification for sentimental reasons, for civic betterment reasons or for political reasons. The case should be in all its phases purely an economical study, and nothing else. And it is, of course, a vastly different question with a railroad which is already designed and built and being operated by steam power, especially in heavily populated section of the country, because into the question there comes the large amount of power which must be disposed of, and the elasticity which we get from electrical operation is somewhat offset by the restriction on account of not being able to distribute power, motive power as the fluctuating business requires. Mr. Murphy very properly put this discussion upon the basis of conservation and that is proper, but above all things it is a purely economical question."

Mr. John Blizzard was particularly interested in the paper given by Mr. Challies. We had two considerations before us, one being that of providing for present emergencies and the other that of looking to the future. It was necessary either to store coal or provide some other form of fuel. With regard to the future it was necessary, as Mr. Challies pointed out, to consider the question as a fuel-power problem. We have in the past been handling the situation in the form form of patchwork but it is now necessary to go further in that respect. The Ottawa Branch had suggested some sort of commission to enquire into this situation. Mr. Leavitt stated that it could be laid down as a fundamental proposition that fuel could be used for heat only and water power for mechanical power considering the question from the viewpoint of conservation. Mr. Murphy raised the query as to whether German gold might be at the back of the propaganda to encourage the use of electrical energy for heating or was it being done for the purpose of making the Kaiser grin?

In concluding the discussion on the use of electricity for heating, Mr. Mitchell stated that electric heat could not be counted on to help solve the fuel problem today.

Smoker

About seventy-five members of the Society gathered in the evening at the rooms of the Engineers' Club, the guests of the Toronto Branch, where a pleasant social session was held, a fitting conclusion to an interesting, instructive and enjoyable conference.

Notes of Professional Meeting

There is a possibility that a Professional Meeting will be held in Halifax in the Fall.

The register showed members in attendance all the way from Winnipeg to Chatham, N.B.

It was a pleasure to have with us the President and Secretary of the Canadian Mining Institute and to have Mr. Dowling take part in a discussion.

The authors of the papers presented deserve particular thanks, because they were prepared on short notice and were without exception of an unusually high order.

The President and members of the Engineers' Club have placed our organization under a deep debt of gratitude to them for the kindness and courtesy in placing the Club quarters at the disposal of visiting members.

The Council was well represented by the President, Mr. H. H. Vaughan, Vice-President, Prof. H. E. T. Haultain, Past President, Mr. G. H. Duggan and Councillors, Messrs. White, Murphy, Gillespie, McCarthy and Safford.

Whoever hinted that because the meetings were being held in Toronto they would be dry, made a wrong guess, the only dryness in evidence was indicated by a longing on the part of some of the Ottawa members to get back to the vicinity of Hull.

A cordial invitation was extended from W. P. Brereton, City Engineer of Winnipeg, on behalf of the Manitoba Branch to the next Professional Meeting to be held at Saskatoon, August 8, 9 and 10th. Mr. Brereton represented the Manitoba Branch officially at the meeting.

The delegation from Hamilton decided that they would no longer be considered as non residents of the Society and steps have been taken for the formation of the Hamilton Branch, and the men from Hamilton hope that the next Professional Meeting in Ontario will be held in their City.

Registration at First General Professional Meeting, Toronto,

March 26th-27th, 1918.

Professor Peter Gillespie........... Toronto.
Professor H. E. T. Haultain........ Toronto.
R. F. Uniacke.................... Ottawa.
A. E. Smaill...................... Ottawa.
D. T. Black...................... Welland.
E. T. J. Brandon.................. Toronto.
H. H. Vaughan.................... Montreal.
Ernest V. Moore.................. Montreal.
Willis Chipman................... Toronto.
Edgar Stansfield.................. Ottawa.
Geo Hogarth...................... Toronto.
J. A. Freeland.................... Toronto.
James White...................... Ottawa.
John Blizard...................... Ottawa.
George F. Porter.................. Montreal.
A. H. Harkness................... Toronto.
A. L. Hertzberg................... Toronto.
Clyde Leavitt..................... Ottawa.
B. F. Haanel...................... Ottawa.
A. L. Mudge...................... Toronto.
Alfred Stansfield.................. Montreal.
A. W. G. Wilson.................. Ottawa.
Chas. J. Crowley.................. New York.
Wm. W. Gunn.................... Toronto.
N. A. Burwash.................... Toronto.
Samuel Bulley.................... Toronto.
N. E. D. Sheppard................ Ottawa.
A. C. McMaster................... Toronto.
Geoffrey Stead.................... Chatham, N.B.
A. Anrep......................... Ottawa.
H. S. Van Scoyoc................. Montreal.
Walter Ziegler.................... Toronto.
J. Honike........................ Lorain, Ohio.
H. G. Salisbury................... Toronto.
A. E. Caddy...................... Campbellford.
D. H. Gunn....................... Toronto.
Geo. Phelps...................... Toronto.
H. W. D. Armstrong............... Toronto.
John H. Curzon................... Toronto.
C. H. Grace...................... Hamilton.
A. A. Dion....................... Ottawa.
E. C. H. Dowson.................. Toronto.
H. E. G. Watson.................. Toronto.
W. T. Harvey..................... Toronto.
W. K. Greenwood.................. Orillia.
Edw. Webb....................... Contract Record.
J. B. Challies..................... Ottawa.
B. E. Norrish..................... Ottawa.
W. F. T. Bryn.................... Ottawa.
C. H. Attwood.................... Ottawa.
R. B. Evans...................... Toronto.
N. L. Crosby..................... Toronto.
N. V. Barber...................... Toronto.
D. B. Dowling..................... Ottawa.
William Gore..................... Toronto.
R. L. Dobbin..................... Peterborough.
Chas. W. Burroughs............... Hawkesbury, Ont.
E. J. Finley...................... Montreal.
E. R. Gray....................... Hamilton.
G. G. Gale....................... Ottawa.
M. Wolsley....................... Toronto.
Fraser S. Keith................... Montreal.
R. O. Sweezey.................... Montreal.
E. L. Cousins..................... Toronto.
O. Lefebvre....................... Montreal.
A. T. Tomlinson................... Lindsay, Ont.
W. S. Tomlinson.................. Toronto.
R. B. Rogers...................... Peterborough.
W. J. Dick........................ Ottawa.
W. A. McLean..................... Toronto.
Frank Barber..................... Toronto.
John D. Evans.................... Trenton.
G. A. McCarthy................... Toronto.
J. D. Barnett..................... Stratford, Ont.
E. B. Merrill...................... Toronto.
A. J. Halford..................... Toronto.
John Murphy...................... Ottawa.
W. R. Rogers..................... Toronto.
E. G. Hewson..................... Toronto.
W. P. Brereton................... Winnipeg.
T. Taylor........................ Toronto.
L. M. Arkley...................... Toronto.
C. H. E. Rowthwaite.............. Sault Ste. Marie.
G. H. Duggan.................... Montreal.
R. O. Wynne-Roberts............. Toronto.
Robt. W. Caldwell................. Montreal.
J. W. Hayward.................... Toronto.
R. Mitchell....................... Toronto.
R. E. Hore....................... Toronto.
M. O. Shapley.................... Toronto.
J. R. W. Ambrose................. Toronto.
J. W. Robson..................... Montreal.
G. E. Evans...................... Toronto.
F. W. Young..................... Toronto.
T. Wilkie......................... Toronto.
Frederick Burnett................. Toronto.
W. P. Merrick.................... Toronto.
W. P. Near....................... Ste. Catherines.
Albert Grigg...................... Toronto.
L. R. Jarvis...................... Toronto.
F. W. Thorold.................... Toronto.
R. Ogilvy........................ Hamilton.
F. A. Dallyn...................... Toronto.
T. K. Thornton................... New York.
H. D. Lumsden................... Orillia.
H. W. McAll...................... Toronto.
D. H. McDougall.................. Sydney.
W. Maclachlan.................... Toronto.
R. B. Young...................... Toronto.
H. R. Safford..................... Montreal.
L. Rorke......................... Toronto.
E. H. Darling..................... Hamilton.
John Taylor...................... Hamilton.
W. B. Rutledge................... Toronto.
F. J. Lazier....................... Orillia.
H. A. Brazier..................... London, Ont.
F. Fairlie........................ Toronto.
George W. Allen.................. Toronto.
Jas. Mackintosh.................. Orillia.

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOL. I. No. 1 MAY 1918

The Journal's Inaugural

Your faith that some day an intercommunicating medium would be provided, devoted to the welfare of the Institute and its members, assumes realization in the appearance of this, the first issue of The Journal of the Engineering Institute of Canada.

It is yours.

With you rests the decision as to its future, as to how far it shall be nourished and grow and wax strong in the likeness of the mental and moral qualities of the members of this Institute, for you are its sponsors and its guardians, even its progenitors. Until it has thrown off the swaddling clothes of its infancy, you will, like good parents, be not unduly critical of your own offspring.

Just how human it may become will be determined by the amount of active co-operative interest you take in it. Here, all that pertains to the doings of the Institute, will receive full and free discussion. In it, our activities, our aims and our expectations may find expression.

Each issue will devote attention to the following features:—

1. A report from the Minutes of the previous meeting of Council, including a list of elections and transfers.
2. A report from each branch containing a monthly survey, including meetings, discussions and plans also personal activities of the members of the branch.
3. The preliminary list of applications for admission and transfer heretofore sent by mail.
4. Advance proofs of all papers to be published in the Transactions.
5. Advance proofs of papers to be presented at General Professional Meetings.
6. Branch papers of merit, in advance when possible.
7. Discussion on any of these papers.
8. Correspondence dealing with all matters of general interest to the welfare of the engineering profession, such as proposed legislation, status, increased recognition, public service and our relations with other engineering bodies and those outside the profession.
9. Letters from our men at the Front, giving personal glimpses or any information concerning their splendid work.
10. Personals, changes of place or position.
11. An engineering index or review of current engineering literature.
12. An employment bureau, designed to help members in obtaining desirable positions and to enable those employing engineers to secure the men they need. This service will be entirely without charge.
13. And as contained in the eleventh clause, section sixteen of the By-Laws, describing the functions of the Secretary, it, "shall also perform such other duties as may be assigned to it by the Council."

The New Name

The name, The Engineering Institute of Canada, was officially recommended by the Committee on Society Affairs at the same time that this Committee submitted the new By-Laws. That the change in name met the general approval of all was shown by the overwhelmingly large majority in favour of the new name, demonstrated by the return of the ballot opened at the Annual Meeting on January 23rd. Council appointed a committee, consisting of the President and Messrs. R. A. Ross and Walter J. Francis to take the necessary steps to secure the legal adoption by the Society of the name, The Engineering Institute of Canada. A Bill was presented to Parliament for this purpose which reads:—

> An Act respecting The Canadian Society of Civil Engineers and to change its name to "The Engineering Institute of Canada."
>
> Whereas The Canadian Society of Civil Engineers has by its petition prayed that it be enacted as hereinafter set forth, and it is expedient to grant the prayer of the said petition: Therefore His Majesty, by and with the advice and consent of the Senate and House of Commons of Canada enacts as follows:—
>
> 1. The name of The Canadian Society of Civil Engineers, hereinafter called "the Institute", is hereby changed to "The Engineering Institute of Canada," but such change in name shall not in any way impair, alter or affect the rights or liabilities of the Institute nor in any way affect any suit or proceedings now pending or judgment existing either by or in favour of or against the Institute which notwithstanding such change in the name of the Institute, may be prosecuted, continued, completed and enforced as if this Act had not been passed.
>
> 2. Sections two, three and five of chapter one hundred and twenty-four of the statutes of 1887, are amended by striking out the word "Society" wherever it occurs in the said sections and substituting therefor the word "Institute."

Sir Herbert Ames kindly sponsored this Bill in the Commons and in a letter received from him under date of April 17th, he advised that the Bill had passed the Private Bills Committee of the House of Commons and went through the Lower House without amendment on April 11th.

In the Senate, Senator Casgrain who was the only corporate member of the Institute in either the Commons or Senate at Ottawa, when the suggestion was made to him regarding seeing the Bill through the Senate stated that he was glad to have the opportunity. The Bill passed the Senate on April 25th, but before its use was legal it was still necessary to receive the assent of the Governor-General. This has just been given.

Provincial Divisions

There seems to be some misunderstanding regarding the formation of provincial divisions. It is intended that the Branches in any province shall take the initiative regarding the formation of such provincial divisions, and in complying with the By-Laws, which require a request from the majority of the members residing within any province, it is intended that headquarters shall communicate with the members, by means of return cards, first to enable the necessary regulations to be complied with and second to save the Branches the trouble and expense of communicating with all the men in the province. There is hope that immediate steps will be taken for the formation of provincial divisions where such do not now exist.

Menacing Legislation Frustrated

The executives of the Victoria and Vancouver Branches deserve the thanks of the entire engineering profession in Canada, for their activity in strenuously opposing legislation, calculated to mitigate against the profession and aimed to give powers to a group of men in British Columbia who were in no way representative.

When attention was brought to Council concerning this bill to incorporate the Engineering and Technical Institute of British Columbia, giving it power to hold examinations and issue certificates, which would have behind them the sanction of the Government, by our zealous members in British Columbia, Council immediately agreed to employ legal counsel and promised the hearty co-operation of headquarters in preventing the passing of the bill.

It is a matter of sincere congratulation that owing to the opposition which developed the bill in question was thrown out. Mr. F. W. Anderson, M.L.A., a corporate member of this Institute, who represents the district of Kamloops in the British Columbia Legislature and who was recently elected chief whip of the Government party, used his position and influence in co-operating to defeat the bill.

That this attempt in British Columbia has been fully frustrated is shown in a letter to the Secretary under date of April 10th, from the Hon. John Oliver, Prime Minister of British Columbia, as follows:—

Dear Sir:—

I am in receipt of your telegram dated the 9th inst., intimating the adoption of the name "Engineering Institute of Canada," last October, by the Canadian Society of Civil Engineers, and deprecating the adoption of a similar name by another organization.

In reply I may say that the Bill relating to this application was reported upon adversely by the Private Bills Committee of the House, and, therefore, will occasion no further consideration.

I am, dear Sir,
Yours truly,
(Signed.) JOHN OLIVER.

The above letter was a direct reply to a night letter sent to the Premier on April 9th, as follows:—

Hon. John Oliver,
Premier British Columbia,
Victoria, B.C.

The CANADIAN SOCIETY OF CIVIL ENGINEERS officially adopted name ENGINEERING INSTITUTE OF CANADA last October. We have British Columbia division, embodying practically all engineers of standing in province; also strong branches, Vancouver and Victoria. It would be unfortunate if any similar name be given proposed organization. You would lower the standard of the profession in British Columbia by granting provincial powers to small group most of whom have not necessary qualifications for membership in the national organization. Would you kindly have F. W. Anderson Kamloops and A. E. Foreman inform you regarding high standard required for membership in our organization. You will then agree that any legislation affecting engineers should be through the provincial division of this Institute such as exists in Quebec and Manitoba.

Gratifying Engineering Appointments

The recent appointment of three members of this Institute to high places calling for executive responsibility shows clearly and unmistakably, (although as yet in an altogether too limited manner), that the field for the engineer who possesses executive ability is assuming a broader sphere and that the recognition that is bound to come to the profession has at least made a start in this country.

Montreal Civic Administrator

By an order of the lieutenant-governor-in-council of the Provincial Legislature of Quebec, passed on April 5th, five men were named to administer the civic affairs of Montreal and the noteworthy appointment in this connection as far as the engineering profession is concerned, was that of Mr. R. A. Ross, consulting engineer of Montreal. Mr. Ross is a past vice-president of the Institute, a present member of Council and an outstanding man in the engineering profession in Canada. His ability in handling big problems is well-known and while the offer of this position was a personal tribute to Mr. Ross, his acceptance does him greater credit, for in doing so it means sacrifice to him and is an evidence of his good citizenship and high sense of public duty.

Dr. Herdt on Tramways Board

A permanent Tramways Commission was appointed for Montreal on April 17th empowered by an order of the lieutenant-governor-in-council of Quebec province, which has been given wide powers in connection with the new franchise accorded to the Montreal Tramways Co. It was evident that at this appointment there should be at least one engineer and the choice of Doctor L. A. Herdt, Macdonald professor of electrical engineering, McGill University, who was for five years a member of Council, is a good one. Doctor Herdt has received many tributes to his ability as an expert adviser in electrical affairs and the latest is one which will give further scope to his usefulness and capacity, both of which have already been proven.

Manitoba Fuel Controller

When C. A. Magrath, M.E.I.C. decided on an appointment of a Fuel Controller for Manitoba and chose Mr. Thos. R. Deacon, M.E.I.C., former mayor of Winnipeg, President of the Manitoba Bridge and Iron Works, Ltd., the appointment was given universal approval throughout Manitoba and is noted with pleasure by the engineering profession.

Mr. Deacon's first official act was to issue a warning regarding ordering coal early, as follows:—

"The people of Manitoba must get their coal by Sept. 30th or they will go without it next winter," he said. "I will do my best to induce all to get their orders in early and to get enough coal into the province to meet all requirements. Those who do not heed the warning will spend a cold winter."

Ottawa Branch News

Under the Chairmanship of Mr. G. Gordon Gale, Vice-President and General Manager of the Hull Electric Railway Company, supported by a strong executive committee, the activities of the Ottawa Branch for 1918 promise to be as successful in the interest of the profession, as previous years, notwithstanding the very large number of Ottawa engineers who are serving His Majesty overseas.

As most of the members of the Ottawa Branch are in the Dominion Government Service, the atmosphere of the Ottawa Branch is distinctive, but it is very noticeable that the "red tape" and circumlocution for which "departmental" Ottawa is famed, is lacking in the affairs of the Ottawa Branch. It has always been a consistently and persistently constructive unit in the general affairs of the Society and, in the readjustment that the Society organization is now undergoing, its considerate and sympathetic influence is an important factor in assuring a successful future for our profession in Canada.

Since its organization in January 1909, the Ottawa Branch has been very fortunate in being served by the following Chairmen:—

C. R. Coutlee	1909.
W. J. Stewart	1910.
A. A. Dion	1911.
S. J. Chapleau	1912.
R. F. Uniacke	1913.
G. A. Mountain	1914.
A. St. Laurent	1915.
John Murphy	1916.
A. Gray	1917.
G. G. Gale	1918.

The Branch has been equally happy in its choice of Secretary-Treasurers, Mr. H. Victor Brayley serving from the organization of the Branch until 1913; Mr. A. B. Lambe from 1913 to 1915; and Mr. J. B. Challies from 1915 to date.

Since the commencement of the war, the Ottawa Branch has had no permanent headquarters, but this has proved no handicap to frequent and very enthusiastic meetings. The practice of having a monthly luncheon at the Chateau Laurier at which men prominent in public and professional life are the guests of the Branch, has proven to be an important factor in getting the engineers together for the purpose of mutual acquaintance and discussion of professional matters. The regular monthly evening meetings of the Branch, held in the lecture room of the Carnegie Library, confined to the reading and discussion of technical papers, have been well attended.

The history of the Ottawa Branch indicates that the esprit de corps of engineers in a particular locality can be measured by the services rendered through the national Society, to the engineering profession generally. Although there are many active members of prominent foreign engineering societies, Ottawa engineers have realized that in the Ottawa Branch of The Engineering Institute of Canada, there was ample scope for their personal intercourse and professional advancement. Proposals for the formation of local branches of foreign engineering societies and associations have never even been proposed, and if they had been would have received short shrift.

The practice of this Branch in issuing a year book with the names and addresses and official position of members of the Society, has proved of great assistance, not only to engineers resident at Ottawa, but particularly to those who come to Ottawa occasionally and desire to know "who's who" in engineering at the Capital. Copies of this year book can be obtained either from the General Secretary at Montreal, or from the Secretary of the Branch, Union Bank Building, Ottawa.

Engineering Service for Canada

The question of the status of the engineer in the Government Service has been a bone of contention among engineers employed by the Dominion, ever since Confederation. Engineers living at Ottawa have been encouraging the establishment of an engineering service for Canada which would be comparable to the engineering service of India, Australia and other British dominions. As a result of crusades for such a service, there was formed, several years ago, a strong committee representing the different Government departments to take up the question and secure definite results. This committee was very active for a few years previous to 1911 and secured the endorsement of their proposals by the then Premier, the Right Honourable Sir Wilfrid Laurier. The matter even got so far as the printing of a comprehensive Bill for introduction in Parliament but for various reasons, over which the engineers had no control, the matter was allowed to lapse, and it was just about to be taken up again actively with the administration of the Right Honourable Sir Robert Laird Borden when the war broke out. Owing to the dislocation of work and the taking on of additional responsibilities by engineers in the Government employ, and their natural reluctance to raise the question of their own status during the war, the matter of an engineering service was allowed to remain in statu quo until the manifesto issued by the present Premier previous to the last general election, which included a definite statement against patronage in appointments and promotions, and in favour of efficiency in all branches of Government Work. In view of this manifesto, the committee of Government engineers referred to, considered the time was opportune to again take up the question of the status of the engineer in the Government employ and to consider whether the engineers of Canada should request the Government to, under present conditions, establish an engineering service. A strong special committee was appointed to go into the matter thoroughly. This committee is still at work, but it is understood that conferences with the Government in the premises will be held in the near future.

The status of the engineer in the Government employ at the present time, depends upon whether he is on the Inside Service or the Outside Service. If on the Inside, except in one or two very special cases, he is simply classed as a clerk and receives the same annual increase as the messenger or file clerk in his office; and cannot be promoted unless a clerk, (in ninety cases out of a hundred a clerical clerk), ahead of him dies or resigns. If he is on the Outside Service, he, under past conditions, has been more fortunate, as it has been possible to recognize ability and service by appropriate salary increases. Under the Civil Service Bill which is now before Parliament, provision is made for a reclassification of the Outside Service of all Government departments. This involves the creation of a definite prescribed organization on the Outside Service similar to that of the Inside Service. Unless the engineers in the various Dominion departments of the Outside Service are placed in an engineering service as distinct from clerical service, they will find themselves in as unfortunate a position as their confreres on the Inside Service. It is very gratifying to know that in at least one of the large departments of the Government Service, employing many engineers, it is proposed to have in the Outside Service a definite engineering

service in which engineers only will be classified. This indicates that in at least one Department those in authority have seen the light. It is reasonable to expect that if an engineering service is successfully organized and maintained on the Outside Service of one Department, that other Departments will follow suit, and after all departments have made such provision for their Outside Services, the natural result will be something similar for the Inside Service. The establishment of an engineering service for Canada is therefore a reasonable possibility and in the near future.

First General Professional Meeting Gets Results

In the various departments of the Federal service, there are engineer officials who have given the fuel power problems of the country intensive study, and have already accumulated in their respective offices, a great deal of valuable information respecting the available supply for present use, and the possibility of future use, of the fuel-power resources of the Dominion. It has long been recognized that such information should be collated and systematized so that it may be used as the basis of a study for determining the most advantageous use of our water powers for commercial and industrial purposes, having in mind the co-ordinating of both water and fuel resources.

So far as the present or the immediate future is concerned, the fuel requirements of the country are being handled with marked ability by Mr. C. A. Magrath. Responsibility for a satisfactory solution of the complicated power situation in the Niagara zone, especially for the munitions manufacture requirements, is with the Dominion Power Controller, Sir Henry Drayton; but until the fuel-power meeting of the Society in Toronto was held, there was little thought given to the necessity for a national fuel-power policy for the Dominion, which would realize the maximum advantageous *future* use of the water power and the fuel resources of Canada. The evolution of such a policy is an urgent necessity, and it is with this object in view that the Government has formed a Dominion Power Board, consisting of nine engineers, of which a member of the Government is chairman. This Board is charged with the responsibility of collecting and collating all the informations available in the various Government departments regarding the fuel and power resources of Canada, supplementing this information with such additional data as may be found advisable; co-ordination of effort of all the different Government departments in an investigation of water and fuel resources; conferring with power and fuel producing interests, experts in the development and use of power, provincial or Dominion commissions, councils or boards interested in the various power-producing agencies of the Dominion. All with the object of effecting a national fuel-power policy for Canada.

Fuel Controller Effects True Conservation

Mr. John Murphy, having put in a very strenuous winter with the Niagara Power Controller, has more recently been assisting Mr. C. A. Magrath, Dominion Fuel Controller, in the latter's campaign for the substitution of hydro-electric power for coal. It was through Mr. Murphy's efforts that the change from steam to electric energy was recently carried out in Montreal, whereby a saving of about 40,000 tons of coal, per annum, will it is said, be made at the Steam Plants of the Montreal Tramways Company.

Town Planning

The spread of the Civic Improvement spirit in Canada has made such gratifying progress that the establishment of a Town Planning Institute is looked forward to with keen anticipation by many engineers, surveyors and architects who are interested in the advancement and application of the science. At the last annual meeting of the Dominion Land Surveyors, held in Ottawa recently, Mr. Noulon Cauchon urged the Surveyors to take up the study of the subject as affording an opportunity of sharing in and guiding the economic recuperation of this country after the war.

The adoption and the implementing of town planning acts being urged upon the Provincial Governments will, where successful, entail the employment of qualified men for the purpose. In the United States there are several courses in town planning and landscape architecture, but Canada so far is lacking in such opportunities for her own men to fit themselves. To this end a curriculum is being tentatively drafted with a view to Courses and Lectures which, it is hoped, will enable the merit of certificates and degrees entitling Canadian Engineers, Surveyors and Architects to fulfil the scope and intentions of the Acts.

Research Council Appoints Secretary.

The action of the Government in connection with the Secretaryship of the Honorary Advisory Council for Scientific and Industrial Research, evidences the value of engineering training for executive work. Mr. Lesslie R. Thomson, formerly of the Dominion Bridge Company staff, has been appointed permanent Secretary. Mr. J. B. Challies, who has been acting as Honorary Secretary of the Research Council since its organization, will continue as Honorary Recording Secretary.

New Parliament Buildings Near Completion

Except for the main tower which is to be 260′ high, all the steel work of the new Parliament Buildings is placed. During the early summer it is expected that a considerable portion of the buildings will be ready for occupation by various Government offices which are now being crowded out of their numerous commercial buildings in various parts of Ottawa. It is not considered possible for the House of Commons and the Senate Chambers to be completed in time for the occupation of Parliament at the next Session, but it is expected that they will be for the following Session. There are said to be several unique and new methods successfully adapted in the scheme of construction and in the heating and ventilating systems of this important structure. On the invitation of the engineers in charge of the work, members of the Ottawa Branch with their friends will pay a visit to the new Parliament Buildings in the near future.

Visit to New Intake Works

As soon as weather conditions will permit, the members of the Ottawa Branch and their lady friends will be the guests of Mr. J. B. McRae, Consulting Engineer, Ottawa. at a general inspection of the new intake works and pumping station of the Corporation of Ottawa, which were designed by Mr. McRae and constructed under his personal direction.

Mr. Dick Goes West

Recognizing the call to larger activities, Mr. W. J. Dick, Consulting Mining Engineer of the Commission of Conservation, has resigned from the Government Service, to go into private consulting practice in western Canada, with head office at Winnipeg. During his sojourn in Ottawa, Mr. Dick has been one of the most active members of the Society, having served for several years on the Managing Committee of the Branch. His experience in Society affairs in Ottawa, and his knowledge of engineering conditions in eastern Canada should prove of great assistance to the work of the Manitoba Branch. It was with sincere regret that the Ottawa Branch parted with Mr. Dick.

Mr. Seymour goes to Halifax.

Mr. H. L. Seymour of the Commission of Conservation, leaves shortly for Halifax, where he is to assist in the work undertaken by the Halifax Relief Commission.

Formation of New Branches

The present year has seen the formation of branches at Montreal, St. John and Halifax. This illustrates the increasing activity of Institute affairs.

Montreal Branch

The first illustration of the increased activity under the new By-Laws was an application received by Council at the special meeting held on January 23rd (the last day of the Annual Meeting). This application was presented as follows:—

"We, the undersigned Corporate Members of the Canadian Society of Civil Engineers, resident within twenty five miles of headquarters, respectfully request that the Council may grant permission to establish "The Montreal Branch of the Canadian Society of Civil Engineers," and was signed by:

R. M. Hannaford	Alex. Bertram
R. S. Lea	L. G. Papineau
Frederick B. Brown	J. A. Duchastel
J. A. Burnett	W. Chase Thomson
Geo. K. McDougall	H. P. Borden
Onisphore H. Côté	M. Brodie Atkinson.
R. W. K. Massey	R. DeL. French
A. J. Matheson	H. G. Hunter

The request was granted and the Secretary instructed to notify members in District No. 1 of the Council's permission to establish the Montreal Branch. The organization meeting of the Montreal Branch was held on February 14th, at which a nominating committee was appointed consisting of:—

R. M. Hannaford	W. Chase Thomson
Frederick B. Brown	M. Brodie Atkinson
L. G. Papineau	H. G. Hunter
J. A. Duchastel	

who were appointed to nominate at least two candidates for each of the following branch offices: chairman, vice-chairman, secretary-treasurer, and six committee men; the chairman, vice-chairman and secretary-treasurer to be elected for one year and the committee men for two years; in the case of the first election, the three committee men receiving the largest number of votes to remain for two years and the remaining men to retire at one year. On the 28th February, the nominating committee submitted a report and a letter ballot was issued by the Secretary of the Society sent to all corporate members within twenty-five miles of headquarters which was returnable, March 14th. At the meeting held on March 14th, the report of the scrutineers showed the following officers for the Montreal Branch, Walter J. Francis, chairman; Arthur Surveyer, vice-chairman; Frederick B. Brown, secretary-treasurer; executive committee:—F. P. Shearwood, H. G. Hunter, W. Chase Thomson to hold office for two years; and L. G. Papineau, O. O. Lefebvre, K. B. Thornton for one year.

Since its organization the Montreal Branch has decided to have four sections as provided for under the new By-Laws, which will be mechanical, electrical, civil and industrial. A petition signed by forty corporate members of the branch has been submitted to the Executive, it being intended that arrangements will be made immediately for the fall session.

The membership of the Montreal Branch is 476.

Halifax Branch

The formation of the Halifax Branch completes the chain from ocean to ocean of Societies under one national organization, wherein the welfare of the members of the engineering profession is receiving consideration.

The commencement of a branch in Halifax involved more than the mere organization of the Branch, inasmuch as there has existed for some years the Nova Scotia Society of Engineers with headquarters at Halifax and membership throughout the province. This Society was started originally by members of the Canadian Society and it had grown to include many who were not. Under the By-Laws of the parent Society it was not possible to take over the Nova Scotia Society as such and our members in Halifax were opposed to any move, which would infringe in any way upon the benefits enjoyed by the members of the Nova Scotia Society who did not belong to the national organization. The good sense and diplomacy of the men in Halifax was demonstrated in the outcome of the negotiations leading up to the decision to disband the Nova Scotia Society for the purposes of merging it into a branch of the Institute at Halifax.

On Friday evening, April 8th, an enthusiastic meeting of corporate members of the Society was held in the Green Lantern Cafe at Halifax, following an informal dinner, at which C. E. W. Dodwell presided. At this meeting the Secretary explained the plans being made for the development of the engineering profession under the new By-Laws and under the new name. After a well rounded out discussion this meeting decided to immediately apply to Council for permission to establish the Halifax Branch. This application was signed by:—

C. E. W. Dodwell	Hiram Donkin
Philip A. Freeman	J. R. Freeman
Roderick McColl	Kenneth H. Smith
T. M. Schenk	Chas. A. Hodge
J. McD. Campbell	W. P. Morrison
F. H. McKechnie	A. C. Brown.
J. F. Pringle	L. G. Van Tuyl
J. N. Finlayson	F. A. Bowman
J. L. Allan	

and presented to Council on March 19th, when permission was granted. In the meantime negotiations were taken up with the Nova Scotia Society of Engineers and at the meeting held at the Nova Scotia Technical College, on Friday afternoon, March 8th, when the Executive of the Nova Scotia met the Secretary representing Council, it was seen that there were no outstanding difficulties in the way of making arrangements for taking over the Nova Scotia Society.

The Minutes of the Meeting of Council of March 19th, show further progress in this connection.

The Secretary reported having taken up negotiations with the Council of the Nova Scotia Society of Engineers with a view to their becoming merged into a branch of this Society. The following resolution was submitted:

Whereas negotiations have been initiated with a view to the Nova Scotia Society of Engineers becoming merged into a Branch of this Society;

Be it resolved that the Council of the Canadian Society of Civil Engineers heartily endorse such a merger and assure the Council of the Nova Scotia Society of Engineers that consideration shall be given to their classification of members of the Nova Scotia Society of Engineers applying for admission to the Canadian Society of Civil Engineers and that such classification shall be accepted so far as it conforms to the by-laws of this Society;

And be it further resolved, that a reduction of three ($3) dollars shall be made from the initiation fee of any applicant for admission from the Nova Scotia Society, such reduction to be considered as a rebate to the newly established Branch.

Approved unanimously.

Following the resolution of the Council, the Annual Meeting of the Nova Scotia Society was held on April 16th. At this meeting arrangements were made that the Nova Scotia Society should dissolve on August 1st and that immediate application be made by all members of the Nova Scotia Society for admission to the Canadian Society.

Minutes of meeting to organize Halifax Branch Canadian Society C.E., held in Technical College, Halifax, Friday, April 19th, at 8 p.m.

On motion of Messrs. W. P. Morrison and Hiram Donkin, Messrs. F. A. Bowman and K. H. Smith were appointed Chairman and Secretary respectively of the meeting.

A copy of the notice calling the meeting was read as follows:—

To the Corporate Members of the Can.Soc.C.E. resident in Halifax

Following authority recently granted by the Council of the Can. Soc.C.E., there will be a meeting held at 8 p.m. on Friday, the 19th of April in the Electrical Engineering Lecture Room at the Technical College for the purpose of completing the formation of a Branch of the Can. Soc.C.E.

Please make a special effort to attend.

(Sgd.) HIRAM DONKIN,
Councillor, Can. Soc. C. E.

The chairman then explained the recent negotiations towards effecting an amalgamation of the Nova Scotia Society of Engineers and the Canadian Society of Civil Engineers, the results of which he stated briefly as follows:—

The Nova Scotia Society is to go out of existence on August 1st next. In the meantime, applications for membership in the Canadian Society are to be sent to all members of the Nova Scotia Society on the understanding that members of the Nova Scotia Society in good standing will be recommended for membership in the Canadian Society to such grade as their respective qualifications and experiences may entitle them. Further, all members of the Nova Scotia Society whose applications for membership in the Canadian Society are placed before the Executive Council of the Nova Scotia Society before August 1st next and approved will receive a rebate on their application fee of $3.00 from the Canadian Society C.E. In addition, all fees paid by an approved applicant to the Nova Scotia Society during the past 2 years will be applied on this applicant's fee covering admission to the Canadian Society, from funds now available in the treasury of the Nova Scotia Society. That is, that in the case of an applicant for membership in the Canadian Society now a member of the Nova Scotia Society whose fees in the latter society are fully paid up and whose application is approved by this society, he will be credited with a total amount of $9.00 on account of his application fee in the Canadian Society being $3.00 from the parent Society and $3.00 each for 2 years' annual fees to the Nova Scotia Society. In case an applicant's fees in the Nova Scotia Society are not fully paid up for the past 2 years he will receive credit for such portion as is paid up. Any funds remaining in the treasury of the Nova Scotia Society will be placed to the credit of the Halifax Branch Can.Soc.C.E.

This was followed by a general discussion in which the concensus of opinion seemed to be that until such time as the amalgamation of the Nova Scotia Society and the Canadian Society is consummated whereby the local membership of the Canadian Society will be considerably increased, a temporary organization only should be affected. It was further considered that this temporary organization should consist of an Executive Committee of 8 members in all, including a Chairman and Secretary with the local Councillor of the Canadian Society as member of this Committee ex-officio. Names of members to act on this Committee were suggested and on motion of Messrs. McColl and Wheaton, the following were appointed to this Committee in addition to the Chairman and Secretary of the meeting then being held,—L. H. Wheaton, W. P. Morrison, P. A. Freeman, J. Lorn Allan, R. McColl.

The complete temporary Executive Committee of the Halifax Branch, Can.Soc.C.E. was then understood to be as follows:—

F. A. Bowman, chairman, K. H. Smith, Secretary-Treasurer, L. H Wheaton, W. P. Morrison, P. A. Freeman, J. Lorn Allan, R. McColl, Hiram Donkin, Local Councillor, member ex-officio.

In a general discussion which followed, it was considered that this Committee should first, facilitate in every possible way the transfer of members of the Nova Scotia Society to the Canadian Society, second, canvas all eligible engineers in the city not now members of either society and third, make all the arrangements necessary for a permanent organization in the way of suggesting by-laws, and various sub-committees.

An effort was made to secure as complete a list as possible of all engineers in the city or vicinity now members of the Canadian Society and also of all those not now members who are eligible either for some grade of membership or as associates.

Before adjournment, the Chairman announced a meeting of the newly appointed Executive Committee for Tuesday evening, April 23rd, in Room 34, Telephone Building."

The fair-mindedness of the men in Halifax is illustrated by the fact that only temporary officers were elected until the other members of the Nova Scotia Society would have an opportunity of securing corporate membership in the Canadian Society and thus be eligible for holding branch office.

St. John Branch

The present year is noteworthy in the engineering annals in the Maritime Provinces, since it already finds two branches organized and offering a scope of activities that will make their influence felt in the profession. For many years the men in the East have felt that they were to some extent isolated, so that the formation of this Branch was a logical development.

On Thursday noon, March 7th, the Secretary on his trip to the Maritime Provinces, met an interested group of members at a luncheon meeting in St. John, who immediately proceeded with the initial organization of the St. John Branch.

Following this meeting an application was forwarded to Council signed by:—

E. T. P. Shewen	G. N. Hatfield
A. Gray	R. H. Cushing
C. C. Kirby	A. B. Blanchard
W. Colin Ewing	Gilbert G. Murdoch
J. K. Scammell	E. G. Horne
H. H. Donnelly	A. R. Crookshank.

This application was presented at the meeting of Council, March 19th, when permission for the formation of the St. John Branch was granted. Mr. A. Gray, chairman of the Ottawa Branch in 1917, was appointed temporary chairman and Mr. A. R. Crookshank temporary secretary. On Thursday, April 4th, a meeting was held at which nominations were submitted for officers of the branch. A letter ballot has been issued and the result of which will be known later.

The membership of the St. John Branch includes:

Crookshank, A. R.	Longley, Horace
Cushing, R. H	Gray, Alex.
Donnelly, Major H. H.	Murdoch, G. G.
Foss, C. O.	Munro, W. A. Jr.
Ewing, W. C	Ryan, H. A.
Innes, R. D.	Scammell, J. K.
Goodspeed, F. G.	Shewen, E. T. P.
Grant, J. A.	Tapley, A. G.
Hatfield, C. N.	Baxter, G. S.
Horne, E. G.	Blanchard, Capt. A. B.
Kirby, C. C.	West, Chas. W.

EMPLOYMENT BUREAU

A Clearing House of Engineering Positions in Canada.

This department is one of the features by which it is hoped to be of greater service to the engineer and particularly the younger men. Firms and individuals requiring engineering assistance will have their inquiries listed in this department. Those out of employment or desirous of a change are invited to make use of it, without charge and in confidence.

Situations Vacant

Superintendents.

Two superintendents wanted for manufacturing plant, who will have general supervision of the plant, one for night and the other for day; must have had experience in handling men and mechanical and electrical experience. These positions offer splendid opportunities. Address applications to Box No. 1, Employment Bureau.

Chemist.

Chemist required capable of making analysis of coal, rock iron, etc., for manufacturing company. Address applications to Box No. 2.

Junior Draftsman.

Junior required for railway drafting office in mechanical department. Address applications to Box No. 3.

Mining Engineer.

Position is open for a junior engineer to commence as surveyor with a large mining corporation in northern Ontario. This position offers good prospects. Address applications to Box No. 4.

Mining Chemist.

Mining chemist capable of making assays of all minerals and of looking after the chemical requirements of a mining corporation. Address applications to Box No. 5.

Heating Expert.

Ontario Municipality requires the advice of a heating and ventilating engineer, one who is not interested in the manufacture of apparatus or appliances. Address applications to Box No. 6.

Transitman.

A Power Co. near Montreal requires a transitman who will have an opportunity of working to a good position. Address applications to Box No. 7.

M. C. for Capt. Harkom

Captain John Harkom, S.E.I.C., son of Col. Harkom, M.E.I.C., of Melbourne, P.Q., has, according to advices just received, been awarded the Military Cross whilst serving with one of the Lancashire batteries of the Royal Field Artillery. Capt. Harkom, who was a science student at McGill when war broke out, enlisted as a gunner with a Montreal battery attached to the 1st Canadian contingent, and was wounded in the early days of the Canadians' fighting in France. After recovery he returned to the service, when he sought and obtained a commission with the Imperial artillery. Capt. Harkom is a student of this Institute.

Hamilton Branch

Proposal to establish the Hamilton Branch is now under consideration and in a letter received recently from Mr. E. R. Gray, City engineer of Hamilton, he advised that steps already taken are developing into action, which might be expected shortly. There is a sufficient number of corporate members residing within 25 miles of Hamilton to make a strong branch and the next issue of the Journal will contain further information in this connection.

Activity at Port Arthur

A letter from Mr. L. M. Jones, City engineer of Port Arthur, shows that while numbers are not sufficient to guarantee an active branch at that centre, the enthusiasm of the men there is all that could be desired.

Port Arthur, April 20th, 1918.

Following up our recent correspondence re the establishment of a branch of the Society at the Head of the Lakes, I would say that I have talked the matter over with a few of the prominent members here and we have come to the conclusion that the present time is not an opportune one to proceed with it.

There are many reasons for reaching this conclusion. First of all, the members of the profession have dwindled in number in this District and are still leaving us on account of the War and conditions brought about by it. Then we have not, at present, enough Corporate members to form a branch according to the constitution.

This could be remedied by having some engineers submit thier names for Membership. We feel that in order to assure a successful branch we should have fairly good numbers and a great deal of undying enthusiasm. The former we have not and the latter is apparent only in spots as there are so many organizations of Patriotic and other kinds these days, that it is difficult to arouse interest. We do not wish to have an organization established and from lack of members and interest, have it prove a failure, as this will be a serious reflection upon the profession and the Society generally.

From the foregoing you will readily understand our position. Personally I hope to see the day when a branch will be established at this location and trust the date is not too far distant, when such will be the case. We are isolated here, as you know, and some of us feel that a little more association with members of the profession, together with opportunities for exchanging ideas and experience would be of immense benefit.

Should you be going through Port Arthur at any time, perhaps you could make it convenient to stop off between trains, when we could get a few members together and talk the matter over. At any rate stop over, the writer would be glad to meet you personally.

Yours very truly,
(Sgd.) L. M. JONES.

With the Poets (?)

Someone sent in the following squib and as there was not time to submit it to the literary adviser, it is reproduced herewith because its philosophy is good.

Heretofore I haven't really been a booster.
Didn't kind of seem to have any juice ter.
Now that the Society's become an Institute,
Let everybody help new plans in bearing fruit.
For I, sure, will take more interest than I uster.

(Later) The literary adviser recommends that poetry should be encouraged but that the punishment should be made to fit the crime. He suggests that the author of the above be shot at sunrise.

Saskatchewan Branch

It was certainly welcome news to receive another proof of the modern and advanced spirit permeating our Society, in the decision to issue a regular "Bulletin". One of the reasons perhaps for a number of resignations of latter years and the lack of interest in several instances towards our Society by a considerable number of members, might be found in the fact, that there was no medium to bridge the large distance between Engineering centres—the members of our profession being in nearly every case residents of urban settlements, which in our sparsely populated Dominion are widely separated.

Even where there is a Branch, covering a whole Province—like our Saskatchewan Branch—it was nearly impossible for a Secretary to keep the members posted as it should have been done, and I am certain that the "Bulletin" will considerably facilitate the work of the Branch Secretaries.

During the present season our Branch has devoted all its energies to the study of two important subjects: "Good Roads" and "Power" and all our meetings are dealing with a series of papers on these subjects. Two Main Committees have been appointed for each one of these topics, which committees in turn have formed subcommittees, drafting every member of our Branch into one of the Subcommittees and making him "work". Considerable progress has already been accomplished and one of our aims is to educate the general public as to the usefulness of our profession. For this purpose we have started to publish in regular intervals some of our most important papers on the subjects in the daily press.

In concluding my contribution, I hope to be able to send in a longer one for the next number of the Bulletin.

J. N. deSTEIN,
Sec.-Treasurer Saskatchewan Branch.

Annual Report Correction

In the discussion on the report of the Committee on Conservation appearing in the second paragraph, page 75 of the Annual Report, an omission of the text after the words "St Lawrence River" gives the impression that Mr. Challies' suggestion was that there should be an international power commission to deal with the water powers of the St. Lawrence River, whereas this refers to the recommendation of the Committee on Conservation. The sentence in question should read, "Further Mr. Challies stated in regard to the recommendation of the Committee on Conservation, 'that there should be an international power commission, to deal with the water powers of the St. Lawrence River', that he was entirely opposed to an international commission dealing with these water powers. Continuing the discussion, Mr. White suggested that he would like to see the Canadian Society of Civil Engineers take up the protection of such water power as is left."

Inasmuch as the report in the Annual Meeting by the omission carried with it an impression entirely opposite to that which was expressed by Mr. Challies, this correction is brought to the attention of the membership.

Society of Civil Engineers Deprecate Street Railway Committee Mode of Enquiry

A strong resolution deprecating the methods adopted by the street railway department was passed unanimously at a recent meeting of the Saskatchewan Branch of the Canadian Society of Civil Engineers, and a copy, which was sent to the city hall, was read at last night's regular meeting of the council. The communication was automatically referred to the special committee for consideration.

The resolution reads as follows:

"Whereas, an investigation has been made of management of the Regina street railway by a pa possessing no special training or experience fitting him intelligently report on the various technical features affect the administration of a transportation system, and,

Whereas, the special committee of the city coun appointed to deal with street railway affairs did, in view the report submitted by their investigator, make cert recommendations to the city council, which reflect on efficiency of the present administration, without hav given the superintendent of the street railway system opportunity to appear on his own behalf.

"Therefore, be it resolved, that the Saskatchev branch of the Canadian Society of Civil Engineers h assembled, do respectfully urge upon the Regina city cou the necessity of appointing as investigators only s parties as are, by training and experience fully qualified thoroughly deal with the matters under consideration.

"Also, that with particular reference to the abo mentioned recommendation of the special committee street railway affairs, this society considers that in accorda with the principles of British fair play, no action should taken by the city council until the superintendent of Regina street railway has been given every opportun to answer any charges which may have been made agai his administration.

"Further, this resolution is forwarded in what believe to be the best interests of civil administrati and is absolutely without prejudice on behalf of any pa or parties affected."

Regina Morning Leader, April 17th.

Report of Council

In the past the doings of Council have been a sea book to the membership and while there are a large num of matters discussed by Council which are essenti confidential, there is much discussed and transacted every meeting, which if transmitted to the members keep all informed, in general at least, in what is transpir at headquarters.

A year ago owing to the great amount of work and large number of items which came before Council discussion, it was decided to establish an Executive Co mittee, consisting of the President, the local vice-preside and the chairmen of the standing committees of Coun consisting of Finance, Papers and Meetings, Legislati Library and House. This year the Committee establis last year has been continued and an additional mem added to the Executive, the chairman of the Publicati Committee, (the former Papers and Meetings Commit now being Papers Committee).

The Executive meets every Monday afternoon, 4:30, thus holding four meetings for each meeting of Coun The functions of the Executive are twofold. It acts an advisory committee to the Secretary and acts in advisory capacity to Council, its report being in the fo of actions taken and recommendations made.

A Future Councillor

On Sunday, April 21st, 1918, at 29 Cliff Road, Toron Ont., to Mr. and Mrs. J. R. W. Ambrose, a son.

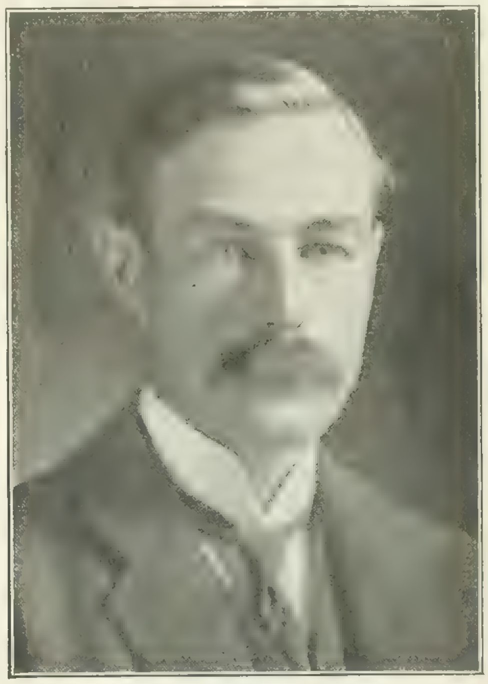
MESSAGES FROM COUNCILLORS TO THE MEMBERSHIP

Through the medium of the Journal an opportunity has been given to Members of Council of conveying a brief message to the men of the Institute. The likenesses are reproduced to give a more intimate contact with the men who are playing a large part in the affairs of the engineering profession in Canada. These messages contain much sage counsel and inspiration. Others will appear in the next issue.

T. H. WHITE, Vancouver,
Vice-President, E.I.C.

My message to the Society is one of cordial congratulation on its awakening, especially during the past two years, to the need of greater activity and more agressiveness in its policies and better co-operation amongst the members living in the Provinces remote from headquarters. This I believe is being accomplished very satisfactorily by the changes made in the By-laws and the stimulating influences emanating from the executive bringing the Society into the closer communion which is essential to its success, and the lack of which was being especially felt by the members in the outlying districts far from Montreal.

T. H. WHITE.



R. F. HAYWARD, Vancouver, B.C.
Vice-President, E.I.C.

By its new Name our society recognizes that all branches of engineering works are so closely interwoven that henceforth technically trained engineers must all be included in the one, the oldest, and the greatest profession in the world "Engineering".

Our members on Active Service are gloriously doing their part in raising the profession to a higher plane.

It rests with those at home to uphold the standard of the profession, and to train young men to fill the gaps caused by the loss of our best in their country's service.

R. F. HAYWARD.

Officers and Members of Council for 1918

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H. H. VAUGHAN, Montreal

VICE-PRESIDENTS
*T. H. WHITE, Vancouver
†H. E. T. HAULTAIN, Toronto
*J. M. R. FAIRBAIRN, Montreal
†R. F. HAYWARD, Vancouver

PAST PRESIDENTS
F. C. GAMBLE, Victoria
G. H. DUGGAN, Montreal
J. S. DENNIS, Montreal

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‡N. E. BROOKS, Sherbrooke
‡ERNEST BROWN, Montreal
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*H. DONKIN, Halifax
*A. E. DOUCET, Quebec
*L. B. ELLIOT, Edmonton
*WALTER J. FRANCIS, Montreal
‡PETER GILLESPIE, Toronto
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*E. D. LAFLEUR, OTTAWA
*D. O. LEWIS, Victoria
†H. LONGLEY, Woodman's Pt. N.B.
*G. D. MACKIE, Moose Jaw, Sask.
‡M. H. MACLEOD, Winnipeg
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‡D. H. McDOUGALL, Sydney, N.S.
‡JOHN MURPHY, Ottawa
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*F. H. PETERS, Calgary
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*D. A. ROSS, Winnipeg
*R. A. ROSS, Montreal
*H. R. SAFFORD, Montreal
†JULIAN C. SMITH, Montreal
‡J. G. SULLIVAN, Winnipeg
*ARTHUR SURVEYER, Montreal
‡L. A. THORNTON, Regina
†JAMES WHITE, Ottawa.

* For 1918 † For 1918-19 ‡ For 1918-19-20

TREASURER
ERNEST MARCEAU, Montreal

SECRETARY
FRASER S. KEITH, Montreal.

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Secretary, C. M. ARNOLD.
Executive, A. S. DAWSON
F. H. PETERS
S. G. PORTER
H. G. SIDENIUS
A. S. CHAPMAN

EDMONTON
Chairman, L. B. ELLIOT
Secretary, A. W. HADDOW.
Executive, D. J. CARTER
J. L. COTE
D. DONALDSON
A. T. FRASER

HALIFAX (Temporary)
Chairman, F. A. BOWMAN
Sec.-Treas., K. H. SMITH.
Executive, L. H. WHEATON
W. P. MORRISON
P. A. FREEMAN
J. LORN ALLAN
HIRAM DONKIN

KINGSTON
Activities discontinued until the close of the war.

MANITOBA
Chairman, W. ARCH'D DUFF
Sec.-Treas., GEO. L. GUY.
Executive, W. P. BRERETON
J. C. HOLDEN
W. M. SCOTT

MONTREAL
Chairman, WALTER J. FRANCIS
Vice-Chair, ARTHUR SURVEYER
Sec.Treas., FREDERICK B. BROWN.
Executive, F. P. SHEARWOOD
W. CHASE THOMSON
H. G. HUNTER
L. G. PAPINEAU
O. O. LEFEBVRE
K. B. THORNTON
and local councillors.

OTTAWA
Chairman, G. GORDON GALE
Secretary, J. B. CHALLIES.
Executive, S. J. FORTIN
J. H. McLAREN
E. B. JOST
C. N. MONSARRAT
A. F. MACALLUM

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Chairman, A. E. DOUCET
Secretary, W. LEFEBVRE.
Executive, ALEXANDER FRASER
J. E. GIBAULT
A. B. NORMANDIN

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Chairman, G. D. MACKIE
Sec.-Treas., J. N. deSTEIN.
Executive, H. S. CARPENTER
A. H. DION
A. R. CREIG
C. J. YORATH
E. G. W. MONTGOMERY

ST. JOHN
Chairman, A. GRAY
Secretary, A. R. CROOKSHANK.
Executive, J. A. GRANT
C. C. KIRBY
G. G. MURDOCH

TORONTO
Chairman, PETER GILLESPIE
Secretary, GEO. HOGARTH.
Executive, J. R. W. AMBROSE
WILLIS CHIPMAN
E. L. COUSINS
H. E. T. HAULTAIN
E. G. HEWSON
R. O. WYNNE-ROBERTS

VANCOUVER
Chairman, E. G. MATHESON
Sec.-Treas., A. G. DALZELL
Acting Sec.-Treas., C. BRACKENRIDGE.
Executive, C. BRACKENRIDGE
H. M. BURWELL
H. E. C. CARRY
T. H. WHITE

VICTORIA
Chairman, R. W. MACINTYRE
Secretary, E. G. MARRIOTT
Treasurer. E. DAVIS.
Executive, W. K. GWYER
E. P. McKIE

J. R. W. AMBROSE, Toronto,
Councillor, E.I.C.

Let us have a greater degree of fraternal feeling and fellowship among the members of the profession and so obtain for each his proper share of the necessities and pleasures of life.

J. R. W. AMBROSE.

* * *

L. B. ELLIOT, Edmonton,
Councillor, E.I.C.

The recent change in name of our Society, is symbolic of the broadened outlook of Engineers, with respect to the opportunities that are theirs for service to their community and to the State. Closely related thereto is the recognition by the community and the State of the value of the engineer's services to our modern industrial Society.

We have come by painful steps to realize, that our rightful place in the scheme of things is something better than that of a mere wage earner. Let us not forget, however, that to make this conviction an actuality will require the earnest support of all our members. Without this co-operation we cannot succeed; with it we cannot fail.

L. B. ELLIOT.

* * *

PETER GILLESPIE, Toronto,
Councillor, E.I.C.

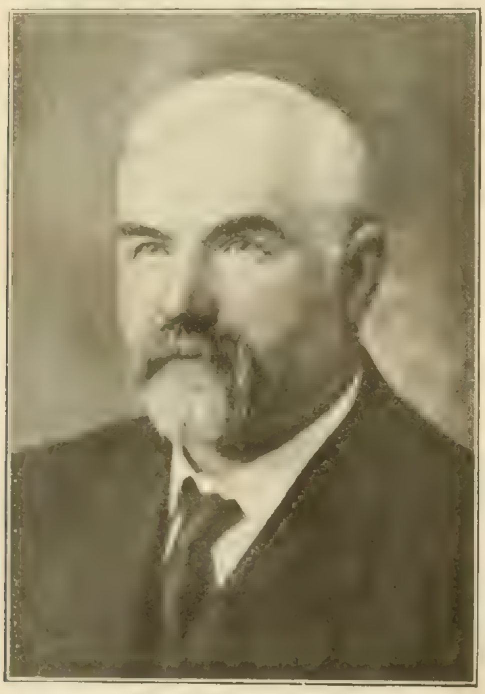
Claims of individuals and of Associations to public recognition must be based on service rendered. In the past the members of the Canadian Society of Civil Engineers have performed services which have merited recognition and many tangible monuments attest this in the history of Canada's development. There is, however, a line of collective activity to which the Institute and its Branches might devote more attention. I refer to those questions of governmental policy, municipal, provincial and federal, properly coming within the purview of the engineer and on which disinterested and authoritative advice is often welcomed by those who control and always recognized by press and public.

PETER GILLESPIE.

D. O. LEWIS, Victoria,
Councillor, E.I C.

To occupy in the community that position to which we are entitled by reason of our great service in the advancement of civilization, we must take a more active part in public affairs. Such a course will contribute to the common good and result in a fuller measure of recognition than in the past. D. O. LEWIS.

* * *



J. H. KENNEDY, Vancouver, B.C.
Councillor, E.I.C.

A back sight over our thirty years of corporate existence as The Canadian Society of Civil Engineers may reveal many short comings and imperfections; but let us each turn for a foresight with renewed confidence, and work in the greater field for usefulness about to open to our society under its new name and constitution; so that when the present great conflict in which so many of our heroes have fallen will have passed. The Engineering Institute of Canada, may take its place among the great elevating institutions of the world.

JAS. H. KENNEDY.

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E. G. MATHESON, Vancouver,
Councillor, E.I.C.

Under the stress of war conditions the Engineer is playing a part commensurate to his training and ability. What a pity that it required the threatened annihilation of the world's liberties to arouse him from his negative attitude toward the world's activities other than those pertaining to his profession.

Now that ideas, long held sacred, because once useful, have been relegated to the scrapheap, the Engineer must not relapse to his pre-war idealism. He must remain an aggressive force; must assert himself in the political and commercial as well as in the professional life of the country. This is a duty he owes to himself, to his profession and to his country.

E. G. MATHESON.

HORACE LONGLEY, Woodman's Point, N.B.
Councillor, E.I.C.

Whatever grievance we engineers have had, that the profession lacked recognition from the public, has been swept away by the great events that are shaking the world. It is every engineer's duty to maintain the status we now enjoy and also to improve it.

HORACE LONGLEY.

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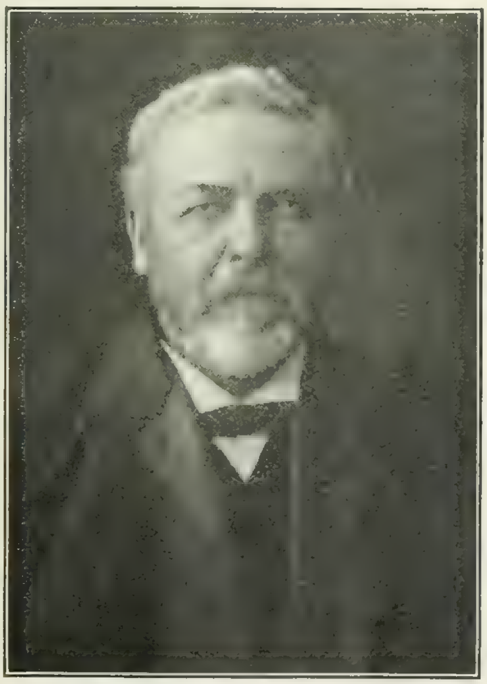

WILLIAM PEARCE, Calgary,
Councillor, E.I.C.

The greatly increased prestige and influence of our Association encourages the continuance of the most aggressive policy possible, thereby impressing the public and through it our political leaders of the vital importance of the interests we represent. This must be carried out to the maximum extent even at risk of the charge "too importunate". Such action coupled with loyal co-operation will undoubtedly attain our aim. Our privilege and duty both demand we should accomplish the greatest possible maximum.

WM. PEARCE.

* * *

H. R. SAFFORD, Montreal,
Councillor, E.I.C.

We seem to be passing through a period when the entire world is being stressed to nearly its Elastic Limit. Social, Industrial and Political structures are being tested severely by stresses for which they do not appear to have been designed and it is apparent that the formulae previously used were inadequate and erroneous because they failed to embody many heretofore unknown factors and they gave false values to many known factors.

The World's Calculus will be revised and rewritten with new formulae and in this work the Engineer has an opportunity to play an important part.

His mental training and education are built upon an Exact Science, not Idealism, and his mind, therefore, follows the lines of analytical thought and honesty of purpose, the two essentials in developing such formulae.

It is an opportune time for him to aggressively interest himself in this study and to unselfishly and patriotically devote all that he can to help to write new specifications and prepare new standard plans for these future Structures to insure, in the finished work, Accuracy, Strength, and, above all, Peaceful Permanency.

H. R. SAFFORD.

J. G. SULLIVAN, Winnipeg, Councillor, E.I.C.

My message to the members could be included in a quotation from Charles M. Schawb's book, "Succeeding with what you have" but I think it better that every member of the Institute should read this book which was published in 1917. It takes only half an hour and costs half a dollar and to my mind it is the best book that was ever published.

J. G. SULLIVAN.

JAMES WHITE, Ottawa, Councillor, E.I.C.

The First Professional Meeting of the Society marks what all members hope is a milestone on the road of progress. All hope, also, that the Second and Third, to be held during the coming summer, will go far toward enabling the East and West to get a better understanding of each other's difficulties and problems. Unfortunately, there has, also, been a feeling in the West that the Society has been managed too much in the interests of the East. It must be our task to demonstrate by word and deed that, whether true or untrue in the past, it will not be true in the future.

JAMES WHITE.

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G. A. McCARTHY, Toronto,

Councillor, E.I.C.

The Membership of the Engineering Institute of Canada have in their hands the moulding of public opinion, as to the value of the Engineer to the public and to the individual. The Council of the Institute must give effect to any constructive suggestions to aid this process of education, when such suggestions are properly supported by the Membership. Now that each district elects its representatives on Council, the matter is largely in the hands of the Branches, whose members should make sure that the best men available are secured for the Nominating Committee and for Councillors.

G. A. McCARTHY.

GENERAL SPECIFICATION FOR STEEL HIGHWAY BRIDGES

(Adopted by Annual General Meeting, 1918, Revised by Committee and Approved by Council.)

INTRODUCTORY.

1. This specification applies to steel highway bridges, including those carrying electric street-cars in addition to the regular highway traffic. Bridges for electric-railway traffic only, or for traffic which includes heavily-loaded freight-cars, shall be designed under the General Specification for Steel Railway Bridges. As this specification has been prepared with a view to its general adoption throughout Canada, and under widely differing local requirements, live-loads, types of flooring, hand-railing, minimum thickness of metal, etc., have been left largely to the discretion of the purchaser's engineer, who is expected to furnish full information on such points, as well as other information called for in appendix IV. Where ordinary conditions prevail, however, the following combinations of live-loads are in general recommended:—

2. For bridges in the manufacturing districts of cities and large towns, subject to the heaviest concentrated loading: Uniform live-load, Class A, paragraph 20, applied to both roadway and sidewalks; one 25-ton motor-truck, as per appendix I; electric-car loads (if any), as per diagram A, appendix II.

3. For bridges in residential districts of cities and large towns: Uniform live-load, Class A, paragraph 20, applied to both roadway and sidewalks; one 15-ton motor-truck, as per appendix I; electric-car loads (if any or if likely to be any in future), as per diagram B, appendix II.

4. For bridges on country highways and in small towns and villages: Uniform live-load, Class B, paragraph 21, applied to roadway only; one 15-ton motor-truck, as per appendix I.

5. For bridges in remote or mountains districts, difficult of access and where the first-cost is the most important consideration: Uniform live-load, Class C, paragraph 22, applied to roadway only; one 8-ton motor-truck, as per appendix I. It is further recommended for such bridges that they be designed for a timber floor, without provision for a future permanent floor; that T-chords be permitted for spans up to 80 feet; that ¼-inch metal be allowed, provided that the structure is not located near salt water or other deleterious elements; and that full-size-punching of rivet-holes be permitted.

GENERAL FEATURES.

Clearances.

6. Unless otherwise specified, the clear width between roadway kerbs shall not be less than 15 feet. For through bridges, the clear width between end-posts shall be at least one foot greater than that between the kerbs, and the clear headroom, between the floor-surface and the overhead bracing, shall not be less than 14 feet, for a minimum width of 6 feet.

Spacing of Trusses.

7. The distance, centre to centre of trusses or main girders, shall not be less than one-twentieth (1/20) of the span, nor less than is necessary to prevent an uplift under the specified wind-load.

Hand-Railing.

8. Suitable steel-lattice or wrought-iron-pipe hand-railing shall be provided outside of the sidewalks; or where there are no sidewalks, outside of the roadway. Unless otherwise specified, hand-railings shall be 4 feet above the adjacent floor-surface, and shall be designed to resist a lateral force on the top rail of 45 lbs. per lineal-foot. When permitted by the engineer, wooden railings may be substituted in place of the above.

FLOOR.

Type of Floor.

9. The type of floor will depend upon local conditions, and shall be as specified by the engineer.

Permanent Floors.

10. Permanent floors, unless otherwise specified, shall be of reinforced-concrete, designed in accordance with the Institute's Specification for Reinforced-Concrete. Both roadway and sidewalk floor-slabs shall be supported upon steel stringers. Roadways shall be properly crowned and provided with suitable wearing-surface. Sidewalk surfaces shall be inclined slightly towards the adjacent kerb, and shall be neatly finished. At the sides of the roadway, substantial kerbs, not less than 6 inches high, shall be provided. Ample facilities for drainage shall be provided; and provision shall be made to carry all drainage clear of the steelwork.

Timber Floors.

11. Unless otherwise specified by the engineer, timber floors shall be supported upon steel stringers, with nailing-strips securely bolted thereto.

12. Timber joists, when used, shall not be less than 3 inches in width, nor shall the depth of any joist exceed four times its width. Joists shall be spaced not more than 2 feet centres; at floorbeams they shall lap by one-another, in order to permit of full bearings; and the ends shall be bolted together, but separated by one-half-inch washers, to permit free circulation of air.

13. The roadway planking, when only one layer is used, shall not be less than 3 inches in thickness, and shall preferably be laid diagonally, making an angle of not less than 60 degrees with the axis of the bridge, and with the heart-side down. When a wearing-surface is specified, the under planking shall be dressed to an uniform thickness of not less than 2⅞ inches; it shall be laid at right-angles to the axis of the bridge, with the heart-side down, and with open joints. The wearing-surface shall not be less than 1½ inches think; it shall be laid at an angle of not less than 60 degrees with the axis of the bridge, and with the heart-side down.

14. Wheel-guard timbers, 4 x 6 inches, shall be provided on each side of the roadway; they shall be set upon blocks 2 inches thick, spaced not over 5 feet, centre to centre, and shall be held in place by a ¾-inch bolt through each block. Joints in wheel-guards shall be half-scarfed, 6 inches long, and supported upon riser-blocks. When specified, the inner edge of wheel-guards shall be protected by a 3 x 3 x ¼-inch angle, fastened thereto by countersunk screws.

15. Planking for sidewalks shall be dressed to an uniform thickness of not less than 1⅞ inches; it shall be laid with the heart-side down, and with ½-inch open joints. When practicable, the sidewalk planking shall extend through the trusses so as to leave no openings, and shall be neatly connected to the roadway planking or to the wheel-guards.

LOADS AND STRESSES.

Weight of Materials.

16. In determining the weight of the structure for the purpose of calculating the stresses, the following unit-weights shall be used:—

Steel	490 lbs. per cu. ft.
Concrete	150 "
Sand or gravel	100 "
Asphalt-mastic	150 "
Bituminous-macadam	130 "
Paving bricks	150 "
Spruce, white and red pine and Douglas fir	3 lbs. per ft. B.M.
Southern long-leaf pine	4 "
Oak and birch	5 "
Creosoted timber	5 "

17. The rails, fastenings and splices of electric tramways shall be assumed to weigh 100 lbs. per lineal-foot of track.

Dead-Load.

18. The dead-load shall consist of the entire weight of metal and other materials in the structure, computed in accordance with the above unit-weights. When a timber floor is specified, and in absence of definite instructions to the contrary by the engineer, provision shall be made in the steel structure to carry a future permanent floor, which shall be assumed to weigh not less than 80 lbs. per square foot of roadway-surface, including kerbs; except for bascule-bridges, lift-bridges and transporter-bridges, which shall be designed to carry a creosoted-timber floor, weighing not less than 40 lbs. per square-foot.

Live-Load.

19. Bridges shall be designed to carry such uniform live-load, motor-truck loads and electric-car loads as may be specified by the engineer, or as follows:—

Uniform Live-Loads.

20. Uniform live-load, Class A: 100 lbs. per square-foot for spans of 100 feet or less, diminishing in a straight line to a minimum of 80 lbs. per square-foot for spans of 200 feet and over. Minimum load per lineal-foot: 1,200 lbs.

21. Uniform live-load, Class B: 80 lbs. per square-foot for spans of 100 feet or less, diminishing in a straight line to a minimum of 60 lbs. per square-foot spans of 200 feet and over. Minimum load per lineal-foot: 900 lbs.

22. Uniform live-load, Class C: 70 lbs. per square-foot for spans of 50 feet or less, diminishing in a straight line to a minimum of 40 lbs. per square-foot for spans of 200 lbs. per square-foot for spans of 200 feet and over. Minimum load per lineal-foot: 600 lbs.

Motor-Truck Loads.

23. Motor-trucks shall be as specified by the engineer, or as shewn in appendix I.

Electric-Car Loads.

24. Electric-cars shall be as specified by the engineer, or as shewn in appendix II.

Impact.

25. Impact shall be added to the maximum computed stresses, produced by the specified motor-truck and electric-car loads only.

26. For motor-truck loads, the impact shall be taken as 30% of the statically computed stresses produced thereby.

27. For electric-car loads, the impact shall be determined by the formula:—

$$I = S\,\frac{150}{L + 300},$$

in which I=impact stress;

S=statically computed maximum stress in member considered, due to electric-car loads.

L=length of load in feet producing the maximum stress in member considered; for structures carrying more than one car-track, L shall be taken as the length of load on all tracks.

Conditions of Loading.

28. In proportioning the trusses or main girders, the uniform live-load shall be assumed to cover the entire width of the roadway, between kerbs; also, when specified by the engineer, the maximum clear width of the sidewalks. The clear width of each sidewalk shall be taken as the distance between the inner edge of the hand-railing and the inner edge of the roadway kerb; except in the case of cantilevered sidewalks on through bridges, when the clear width shall be measured between the inner edge of the hand-railing and the web-members of the near truss. When 75% of the specified live-load on one overhanging sidewalk, only, imposes a greater load on the adjacent truss than that resulting from full live-load on two symmetrically placed sidewalks, such greater load shall be used. In computing truss stresses, full panel-loads shall be assumed at any or all panel-points.

29. Electric-cars shall be assumed to cover the entire length or any portion of each track on the bridge, placed so as to produce the maximum stresses due thereto in every member of the trusses. In calculating such stresses, an equivalent uniform load per track shall be used, equal to the weight of one car divided by its over-all length; and full panel-loads shall be assumed at any or all panel-points.

30. Trusses or main girders, unless otherwise specified by the engineer, shall be designed, 1st, for the uniform live-load; 2nd, for the motor-truck loads, with impact; 3rd, for the electric-car loads, with impact; and the maximum stresses thus obtained shall be used in proportioning the various members. When specified by the engineer, the live-load on sidewalks shall be included in these three conditions of loading.

31. Floorbeams, hangers and other truss-members immediately affected thereby shall be designed, 1st, for the maximum uniform live-load for short spans, of the class specified, applied to the roadway only, or to the roadway and one or both sidewalks; 2nd, for the specified

motor-truck and electric-car loads (with their respective impact-allowances), placed so as to produce the maximum stresses, and with or without the specified maximum load on one or both sidewalks.

32. Sidewalk flooring, stringers and supporting brackets shall be designed for the maximum uniform live-load for short spans, of the class specified.

33. Roadway stringers or joists shall be designed to carry proportions of the specified motor-truck loads, as given by the formula:—

$$C = P\frac{d}{a};$$

in which C=proportion of front or rear wheel-load supported by one stringer;
P=concentration on one wheel, front or rear;
d=distance centre to centre of stringers;
a=gauge, centre to centre, of wheels.

34. Tramway stringers shall be proportioned for the wheel-concentrations of the specified car.

35. The roadway floor shall be designed to carry the maximum wheel-load of the specified motor-truck, which shall be considered as distributed over a length of floor equal to twice the total thickness thereof, and over a width equal to that of the wheel-tire, plus twice the total thickness of the floor.

Wind-Loads.

36. Bridges shall be designed for a horizontal wind-force on the loaded chords of 300 lbs. per lineal foot; and, on the unloaded chords, 150 lbs. per lineal foot; both of which forces shall be treated as moving loads.

37. Viaduct towers shall be designed for a wind-force of 50 lbs. per square foot on one and one-half times the vertical projection of the structure, unloaded; or 30 lbs. per square foot on the same surface, plus 150 lbs. per lineal foot, applied 5 feet above the floor, when the structure is loaded. The longitudinal bracing of the towers shall be proportioned for the same loads as the transverse bracing.

Temperature.

38. Provision shall be made for a variation in temperature of 150 degrees, Farenheit.

Combined Stresses.

39. The various parts of the structure shall be proportioned for the maximum co-existing dead-load, live-load and impact stresses, or for wind-load and temperature stresses alone, by using the unit-stresses herein specified; and, for any combination of wind-load or temperature stresses with dead-load or live-load stresses, the specified unit-stresses shall not be exceeded by more than 25 per cent.

Alternate Stresses.

40. Wherever the dead-load and live-load stresses are of opposite character, only two-thirds of the minimum dead-load stress shall be considered as effective in conteracting the live-load stress. Members subject to reversal of stress shall be proportioned for the condition requiring the larger section; and, if the alternate stresses are produced by the specified motor-truck or electric-car loads, with impact, and occur in succession, as in stiff counters, during the passage of these loads, each kind of stress shall be increased by 50% of the smaller.

Axial and Bending Stresses Combined.

41. Members subject to both axial and bending stresses shall be proportioned so that the combined fibre-stresses will not exceed the allowed axial unit-stress; except such members as may be subject to bending-moments from their own weight, or from eccentricity, when the total fibre-stress shall not exceed the allowed unit-stress by more than 10%; but in no case shall the section be less than required for the axial stresses alone.

42. For members continuous over panel-points and subject to transverse loading, the bending-moments, both at the panel-points and at the centre, shall be taken as three-fourths of that computed as for a simple beam, of span equal to one panel-length.

UNIT-STRESSES.

43. The following permissible unit-stresses are given in pounds per square-inch, except where otherwise noted.

Tension.

44. Axial tension on net section.......... 16,000

Compression.

45. Axial compression

on gross section of columns.............12,000–0.3 $\left(\frac{l}{r}\right)^2$

in which l=length in inches and r=least radius of gyration in inches.

Direct compression on steel castings..........	14,000
Direct compression on iron castings............	10,000

Bending.

46. Bending on

extreme fibres of rolled shapes, built up sections and girders, net section...............	16,000
steel castings..............................	12,000
iron castings..............................	3,000
pins....................................	24,000
white oak, Douglas fir and southern long-leaf pine	1,600
white and red pine and spruce.................	1,100

Shearing.

47. Shearing on

power-driven shop-rivets and pins.............	11,000
power-driven field-rivets......................	10,000
hand-driven field-rivets and turned-bolts.......	8,000
plate-girder webs, gross section................	10,000

Bearing.

48. Bearing on

power-driven shop-rivets.....................	22,000
power-driven field-rivets and pins..............	20,000
hand-driven field-rivets and turned-bolts.......	16,000
hard bronze sliding expansion-bearings.........	1,000
expansion-rollers, per lineal inch...............	600d
in which d=diameter of roller, in inches.	
granite masonry............................	800
Concrete, 1:2:4 mix.........................	600
limestone masonry..........................	400
sandstone masonry..........................	300

PROPORTIONING OF PARTS.

Net Section at Rivet-Holes.

49. In proportioning rivetted tension members, the diameter of the rivet-holes shall be taken one-eight (1/8) inch larger than the nominal diameter of the rivet; and allowance shall be made in each component part of the member for as many rivet-holes as it contains gauge-lines, unless the distance centre to centre of rivet-holes, measured on the diagonal, is at least 40% greater than the distance between the gauge-lines. In every angle, allowance shall be made for at least two rivet-holes.

Net Section at Pin-Holes.

50. In pin-connected rivetted tension members, the net section, both through the pin-hole and back of same, shall exceed the net section of the body of the member by at least 25%.

Limiting Length of Compression Members.

51. No compression or stiffening member shall have a length exceeding 175 times its least radius of gyration; but, for built-up I–sections, the radius of gyration may be computed for the flange materials alone, neglecting the web-plate, in which case the latter shall not be counted on as effective section for axial stresses.

Open Sections.

52. Structures shall be so designed that all parts will be accessible for inspection, cleaning and painting.

Water-Pockets.

53. Pockets or depressions shall be avoided as far as possible; and those which are unavoidable shall either be provided with effective drain-holes, or they shall be filled with waterproof material.

Symmetrical Sections.

54. Main members shall be so designed that their neutral axis will be as nearly as practicable in the centre of the section; and the neutral axes of interesting main members shall meet in a common point.

Minimum Sections.

55. Unless otherwise specified by the engineer the minimum thickness of metal shall be 5/16 inch, except for fillers and for hand-railing.

Plates in Compression.

56. Cover-plates and web-plates of built compression members, also flange-plates of girders, shall have a minimum thickness of

$$t = \frac{pd}{400{,}000};$$

in which t=minimum thickness of metal, in inches;
p=axial unit-stress, in lbs. per sq. in.;
d=unsupported distance between connections to flanges, or distance between rows of connection-rivets, in inches.

Outstanding Flanges.

57. Unstiffened flanges of compression members and girders shall have a minimum thickness of

$$t = \frac{pl}{120{,}000},$$

in which t=minimum thickness of metal, in inches;
p=axial unit-stress, in lbs. per sq. in.;
l=unsupported length of outstanding leg, in inches.

Counters.

58. Rigid counters are preferred. Adjustable counters, when used, shall have open turnbuckles.

Pony-Truss Bridges.

59. Pony-truss bridges shall be of rivetted type. Spans of 50 feet, centre to centre of bearings, or less, may have single-webbed trusses with T-chords; but all spans over 50 feet in length shall have double-webbed chords, and latticed or otherwise effectually stiffened web-members, unless otherwise specified by the engineer.

60. In all pony-truss bridges, the floorbeams shall be rigidly connected to vertical truss-members; and stiffening gussets, as large as practicable without interfering with the roadway clearances, shall be provided. The vertical truss-members and the floorbeam connections thereto shall, when practicable, be proportioned to resist, at the specified unit-stresses, a lateral force applied at the top-chord of the truss, equal to 2% of the maximum top-chord stress. When impracticable to design the vertical truss-members sufficiently strong to meet this requirement, outside wing-braces shall be added.

Plate-Girders.

61. Plate-girders shall be proportioned for bending-moments either by the moment of inertia of their net section, or by assuming that the flanges are concentrated at their centre of gravity. In the latter case, one-eight of the gross section of the web-plate shall be assumed as equivalent net section for the tension flange.

Compression Flanges.

62. The gross section of the compression flange of plate-girders shall not be less than that of the tension flange; nor shall the stress per square-inch in the compression flange of any beam or girder exceed $16{,}000-200\frac{l}{b}$ lbs., where l=the unsupported length, in inches, and b=the width of the flange, in inches.

Flange-Plates.

63. When flange-plates are used on plate-girders, they shall extend not less than one foot beyond the point where any portion of their section is needed to make up the required flange area.

Web-Plates.

64. Splices in web-plates shall be avoided as far as possible; but, when necessary, they shall be designed so that the full value of the web-plate will be uniformly developed, both for bending and for shear.

Web-Stiffeners.

65. There shall be web-stiffeners, generally in pairs, over bearings and at points of concentrated loading, Intermediate stiffeners shall be provided when the thickness of the web-plate is less than one-sixtieth (1/60) of the unsupported distance between flange-angles, spaced in accordance with the formula given below; but the clear distance between stiffeners shall not exceed

6 feet, nor shall it exceed the clear depth of the web-plate, measured between flange-angles:—

$$d=\frac{t}{40}(12{,}000-s);$$

in which d=clear distance, in inches, between stiffeners;
t=thickness of web-plate, in inches;
s=shear per square-inch.

66. Stiffeners at end bearings and at points of concentrated loading shall be proportioned as columns, with a unit-stress of 12,000 lbs. per square-inch; they shall be on fillers, and their outstanding legs shall be as wide as the horizontal legs of the flange-angles on which they bear (inside measurement). Intermediate stiffeners may be offset or on fillers, and their outstanding legs shall have a width of not less than one-thirtieth (1/30) of the depth of the girder, plus two (2) inches.

Floor-beams.

67. Floorbeams shall preferably be set at right-angles to the trusses or main girders, and shall be rigidly connected thereto; except in the case of deck bridges, where the floorbeams may rest upon the top-chords, if permitted by the engineer. End floorbeams shall be provided, when possible; and they shall preferably be designed for jacking-up the bridge, if necessary, under which condition the allowed unit-stresses shall not be exceeded by more than 50%.

End-Struts.

68. When impossible to use end floorbeams with through bridges, end-struts and stringer cross-frames shall be provided, which shall be rigidly connected to the stringers and to the trusses or main girders.

Bracing.

69. Lateral, longitudinal and transverse bracing shall be rigid, and shall be proportioned, 1st, so that the unsupported length thereof will not exceed 175 times the least radius of gyration; 2nd, so that the fibre-stress resulting from their own weight will not exceed the allowed axial unit-stress for compression; 3rd, so that the fibre-stress resulting from their own weight, combined with any computed axial stress, will not exceed the allowed axial unit-stress for tension or compression, as the case may be.

70. Through-truss bridges shall be provided with portal-bracing, rigidly connected to the end-posts and top-chords; it shall be proportioned for the total specified wind-load on the top-chords, and shall be as deep as the specified clearance will allow, Furthermore, sway-bracing shall be provided at all intermediate principal verticals; or, in the case of lattice trusses having no intermediate vertical members, on all principal compression web-members. Sway-bracing shall also be as deep as the specified clearance will allow.

71. Deck bridges shall be provided with transverse bracing at the ends, proportioned for the total specified wind-load on the top-chords; also transverse bracing at all intermediate principal verticals; or, in case there are no full-depth intermediate verticals, on all principal compression web-members.

72. Viaduct-towers shall have at their base both transverse and longitudinal struts, proportioned to slide the movable shoes when the structure is unloaded.

73. Through plate-girders shall have their top flange stayed at each floorbeam; or, in case of solid floors, at distances not exceeding 12 feet, by knee-braces or gussets.

DETAIL OF DESIGN.

Eye-Bars.

74. Adjacent eye-bars of a member shall be so arranged that their surfaces will not be in contact. Eye-bars shall be as nearly as possible parallel to the plane of the truss, with a maximum inclination of one inch in 16 feet.

Pin-Plates.

75. Pin-plates shall be of sufficient thickness to make up the required bearing area on the pin; they shall be as wide as the dimensions of the member will allow; and their length, measured from pin-centre to end, shall be at least equal to their width. Pin-plates shall contain sufficient rivets to distribute their due proportion of the pin-pressure to the full cross-section of the member; and only the rivets located in front of two lines, intersecting at the pin-centre and inclined at 45 degrees to the axis of the member, shall be considered effective for this purpose. In case of members composed of web-plates and flange-angles (with or without a cover-plate), there shall be at least one outside pin-plate, covering the vertical legs of the flange-angles.

Forked Ends.

76. Forked ends on compression members will only be permitted when unavoidable; but, when used, a sufficiency of pin-plates shall be provided to make the jaws of twice the sectional area of the member. At least one of these pin-plates shall extend to the far edge of the farthest tie-plate, and the balance shall extend to the far edge of the nearest tie-plate, but not less than 6 inches beyond the near edge of the farthest tie-plate.

Pins.

77. Pins shall be long enough to insure a full bearing thereon of all the parts connected thereby. They shall be secured either by chambered nuts or by solid nuts provided with washers. The screw-ends shall be long enough to admit of burring the thread.

Filling-Rings.

78. Filling-rings shall be provided, where necessary, to prevent lateral movement on pins of the members connected thereby.

Effective Diameter of Rivets.

79. In calculating the number of rivets required, the nominal diameter only, or size of the cold rivet before driving, shall be taken as effective.

Pitch of Rivets.

80. The minimum distance between centres of rivets shall be three times the diameter of the rivet; but, preferably, 3 inches for ⅞-inch rivets, 2½ inches for ¾-inch rivets, and 2¼ inches for ⅝-inch rivets. In members composed of plates and angles, the maximum rivet-pitch in line of stress shall be 6 inches. In built

tension members, the rivet-pitch shall not exceed sixteen times the thickness of the thinnest plate or angle, except in angles having two lines of staggered rivets, where the pitch on each line may be twice this limit. In built compression members, the rivet-pitch shall not exceed twelve times the thickness of the thinnest outside plate or angle, except in angles having two lines of staggered rivets, where the pitch on each line may be one and one-half times this limit.

Rivets at Ends of Compression Members.

81. In built compression members, the rivet-pitch at the ends shall not exceed four times the diameter of the rivet for a length equal to one and one-half times the maximum width of the member; except in angles having two lines of rivets, staggered, where the pitch on each line may be twice this limit, but not greater than that allowed for the body of the member.

Flange Rivets.

82. The number of rivets connecting flange-angles of plate-girders to the web-plate shall be sufficient to develop the increment of flange-stress, combined with any load applied to the flange; and the maximum pitch in the vertical legs of the loaded flange-angles shall not exceed 4 inches on a single line, or 8 inches when there are two lines of rivets, staggered.

Rivets in Wide Flange-Plates.

83. When two or more flange-plates are used, and which project more than 3 inches beyond the edge of the flange-angles, an extra line of rivets shall be driven along each edge; spaced not more than sixteen times the thickness of the thinnest outside plate, for the tension flange; nor more than twelve times the thickness of the thinnest outside plate, for the compression flange.

Edge-Distance of Rivets.

84. The minimum distance from the centre of any rivet to a sheared edge shall be $1\frac{1}{2}$ inches for $\frac{7}{8}$-inch rivets, $1\frac{1}{4}$ inches for $\frac{3}{4}$-inch rivets and $1\frac{1}{8}$ inches for $\frac{5}{8}$-inch rivets; and, to a rolled or planed edge, $1\frac{1}{4}$, $1\frac{1}{8}$ and 1 inches, respectively. The maximum edge-distance for rivets shall be eight times the thickness of the thinnest outside plate, but not more than 6 inches.

Maximum Diameter of Rivets.

85. The diameter of the rivets in any angle channel or beam subject to calculated stress shall not exceed one-quarter of the width of the leg in which they are driven. In minor parts, $\frac{7}{8}$-inch rivets may be used in 3-inch legs; $\frac{3}{4}$-inch rivets in $2\frac{1}{2}$-inch legs; and $\frac{5}{8}$-inch rivets in 2-inch legs.

Long Rivets.

86. Rivets subject to calculated stress, and whose grip exceeds four diameters, shall be increased in number at least one per cent. for each additional one-sixteenth-inch grip.

Turned-Bolts.

87. Turned-bolts may only be used in place of place of rivets by special permission of the engineer.

Strength of Connections.

88. Tensions members shall be connected or spliced for an axial stress equal to their net sectional area, in square-inches, multiplied by 16,000 lbs. per square-inch. Compression members shall be connected for an axial stress equal to their gross sectional area, in square-inches, multiplied by 12,000 lbs. per square-inch. Truss members subject to reversal of stress, shall be connected for an axial stress equal to the numerical sum of the stresses. Lateral, longitudinal and transverse bracing, when subject to reversal of stress, shall be connected for their maximum value, whether in tension or compression.

Compression Splices.

89. Compression members abutting on a pin shall have sufficient bearing thereon to transmit the entire thrust without exceeding the allowable unit-bearing. In rivetted structures, continuous compression members, such as chords and trestle-posts, shall have faced ends and full contact-bearings at the joins when rivetted. All hip-joints, as well as joints in chords subject to transverse loading, shall be fully spliced; other joints shall be spliced for not less than 50% of the axial stress in the members.

Minimum Connections.

90. No member or component part thereof, except lattice-bars shall be spliced or connected by fewer than 3 rivets.

Indirect Splices.

91. Where splice-plates are not in direct contact with the parts which they connect, the number of rivets therein, which would otherwise be required for a contact-splice, shall be increased by 10% for each intervening plate.

Fillers.

92. Rivets carrying stress and passing through fillers shall be increased in number by 20%; and the additional rivets, when possible, shall be outside of the connected member.

Arrangement of Splice Materials.

93. The materials for splices shall be so arranged that the strength of each component part of the member spliced, including legs of angles, flanges and webs of beams and channels, etc., will be fully developed.

Tie-Plates and Diaphragms.

94. The open sides of compression members shall be provided with tie-plates, placed as near the ends as practicable; and, if located farther from the intersection-point than twelve times the width of the outstanding flanges, diaphragms shall be added. Tie-plates shall also be provided at intermediate points where the latticing may be interrupted.

95. In main members, the end tie-plates shall have a length of not less than one and one-half times, and intermediate tie-plates, a length of not less than the perpendicular distance between the lines of rivets connecting them to the flanges; their thickness shall not be less than one-fiftieth (1/50) of the distance between connecting lines of rivets.

96. When intermediate tie-plates are used with tension members instead of latticing, they shall be spaced not farther apart in the clear than fifteen times the width of the flange to which they are attached, and they shall be connected to the member by not fewer than 3 rivets on each side.

Latticing.

97. The latticing of compression members shall be proportioned to resist a cross shear equal to 2% of the axial stress in the member, which shear shall be considered as divided equally between the two parallel planes of latticing.

Minimum Size of Lattice-Bars.

98. The minimum width of lattice-bars shall be 2½ inches for ⅞-inch rivets, 2¼ inches for ¾-inch rivets, and 2 inches for ⅝-inch rivets. The minimum thickness shall be one-fortieth (1/40) of the distance between end rivets, in the case of single latticing; and one-sixtieth (1/60) of this distance for double latticing, rivetted at the intersections. Shapes of equivalent strength may be used instead of flats.

Inclination and Spacing of Lattice-Bars.

99. Lattice-bars shall generally be inclined at an angle of about 60 degrees to the axis of the member, when single latticing is used; and they shall be inclined at an angle of not less than 45 degrees, with double latticing; furthermore, the maximum spacing of lattice-bars shall be such that the ratio l/r for the portion of single flange included between consecutive connections will be smaller than this ratio for the member as a whole.

Expansion.

100. Provision for expansion, to the extent of one inch for each 80 feet, shall be made for all bridge structures. Spans of less than 100 feet may be arranged to slide upon steel plates with smooth surfaces; but spans of 100 feet and over shall be provided with turned rollers or rockers, or with special sliding bearings, as described below.

Roller-Bearings.

101. Expansion-rollers shall not be less than 4 inches in diameter; they shall be connected together by substantial side-bars, and shall be effectually guided so as to prevent lateral movement, skewing or creeping. The rollers and bearing-plates shall be protected from dirt and water, as far as possible, by suitable curtain-plates; and the whole construction shall be such that water will not be retained therein, and that it may be easily inspected and cleaned.

Special Sliding Bearings.

102. Sliding plates for the expansion-bearings of 100 feet and over shall be of hard bronze, or of some other hard non-corrosive materal; they shall be chamfered at the ends, and shall be securely held in position; furthermore, they shall be so arranged that the sliding surfaces thereof cannot become clogged by dirt.

Fixed Bearings.

103. Fixed bearings shall be firmly anchored to the masonry.

Pier-Members.

104. Spans of 100 feet and over shall preferably rest upon hinged or disc bearings, which shall be constructed so as to distribute the load evenly over the entire bearing. Bed-plates may be castings, or they may be of rolled steel.

Anchor-Bolts.

105. Anchor-bolts shall not be less than one and one-quarter (1¼) inches in diameter.

Anchorage.

106. Anchor-bolts for viaduct-towers and similar structures shall be long enough to engage a mass of masonry weighnig not less than one-and one-half (1½) times the amount of the net uplift.

Camber.

107. Trusses shall be cambered, either by increasing the length of the top-chord ⅛ inch per 10 feet; or by so modifying the length of members that the floor-line will be straight when the bridge is fully loaded.

MOVABLE BRIDGES.

Types.

108. Movable bridges may be classified, in a general manner, as follows:—

(a) Swing-bridges, which revolve about a vertical axis;
(b) Bascule-bridges, which lift at one end;
(c) Rolling-bridges, which move horizontally;
(d) Lift-bridges, which move vertically;
(e) Pontoon-draw-bridges, which float on pontoons;
(f) Transporter-bridges, in which a travelling platform, at the toadway-level, is suspended from an overhead fixed-span;

and the type to be adopted for a particular location shall be as specified by the engineer.

Waterway.

109. The minimum clear width of waterway, and the clear height above the water when the bridge is open, shall be as specified by the engineer.

Structural Parts.

110. The structural parts of movable bridges shall be designed in accordance with the requirements herein specified for steel bridges generally, except as modified hereinafter. In proportioning members subject to bending from pin-friction, eccentric connections or other causes, the computed bending stress shall be increased by 25%; and the total fibre-stress, resulting from combined axial and bending stresses, shall not exceed the allowed axial unit-stress.

Alternate Dead-Load Stresses.

111. Members subject to alternate stresses of tension and compression, during the operation of the bridge, shall further be proportioned for either of these stresses, increased by 50% of the smaller; and the connections shall be proportioned for the sum thereof.

Machinery Connections.

112. Members to which machinery is attached, as well as other members affected thereby, shall be designed to meet the maximum force which can be exerted by the motive power, either specified or supplied, or by the maximum force due to retardation by the brakes.

Wind-Load.

113. In proportioning the machinery and supports for same, a horizontal wind-pressure of 15 lbs. per square-foot on the vertical projection of all exposed surfaces of the movable structure shall be assumed; which wind-pressure shall further be taken as acting in any horizontal direction, and at any period during the operation of the bridge. The structure as a whole, with the movable

portion in any position, shall be designed for a horizontal wind-pressure of 30 lbs. per square-foot, similarly applied.

Live-Load for Swing-Bridges.

114. The uniform live-load for swing-bridges shall be as specified for spans of length equal to that of one arm thereof; or, in the case of unequal arms, to that of the shorter arm.

Stresses for Swing-Bridges.

115. In computing the stresses for swing-bridges, continuous over three or four supports, the following cases shall be considered:—

Case I. Dead-load, bridge swinging; or closed, with ends just touching supports;

Case II. Dead-load, bridge closed, with ends lifted sufficiently to produce the full reaction, computed as for a continuous girder;

Case III. Live-load on closed bridge, placed so as to give maximum stresses of tension and compression in every member.

116. The following combinations of stresses shall be considered; and the various members shall be proportioned for that combination which requires the greatest section, taking into account the impact and provision for reversals, specified in connection with motor-truck and electric-car loads only.

Case I, plus 25% for impact;

Case I with Case III and impact, if any;

Case II with Case III and impact, if any.

Turntables.

117. Turntables for swing-bridges may be centre-bearing, rim-bearing, or a combination of the two.

Centre-bearing Turntables.

118. Centre-bearing turntables shall be designed so that the entire dead-load of the bridge, when swinging will be carried on the centre pivot. When the bridge is closed, the trusses or main girders shall be supported at the pivot-pier by wedges or otherwise to provide for the live-load reaction; except in the case of narrow bridges, for which such supports may be omitted, provided that the transverse loading-girder shall be designed to carry both dead-load and live-load. Balance-wheels, running on a circular track, shall be provided for the purpose of balancing the bridge while swinging; which balance-wheels and their supports shall be designed to resist the overturning effect of the specified wind-load, together with an assumed unbalanced load on one end of the bridge, equal to one-half of one per cent. (0.5%) of the total weight of the movable structure, but in no case less than 3,000 lbs.

Rim-Bearing Turntables.

119. In the case of rim-bearing turntables, the loading and distributing girders shall be designed so as to distribute the total dead-load and live-load, thereon, equally among all of the rollers. When a circular girder or drum is used, it shall preferably be loaded at not fewer than eight equidistant points; all splices therein shall be sufficient to develop the full strength of the materials spliced; abutting ends shall be faced; and the bottom shall have a planed surface, centrally located with the web, and of sufficient area to transmit the load thereon to the upper tread without exceeding the allowed unit-bearing.

Treads and Tracks.

120. Upper and lower treads for rim-bearing turntables and tracks for centre-bearing turntables shall be designed sufficiently strong and stiff to distribute the maximum roller or balance-wheel load to the adjacent drum or masonry, without exceeding the allowed unit-bearings thereon; bearing surfaces and abutting ends shall be planed. Lower treads and tracks shall be securely anchored to the masonry, and connected to the centre pedestal casting.

Rollers and Balance-Wheels.

121. Rollers and balance-wheels shall be proportioned so that the allowed bearing thereon will not be exceeded; and shall be turned so as to roll freely on the treads or track. Rollers for rim-bearing turntables shall be effectually held in their relative position by stiff spacing-rings, connected to and revolving about the centre pedestal; and they shall be adjustable, radially. Balance-wheels shall be adjustable, vertically.

Rack-Segments.

122. Rack-segments shall be steel or iron castings; they shall be machined at connections to supports and on the ends, and shall be securely fastened to the lower tread or track, or to the masonry. The fastenings for each segment (including connections to the adjoining segments) shall be sufficient to develop at least twice the full strength of one rack-tooth.

Centre Pedestal Casting.

123. The centre pedestal casting shall be of steel or iron, and shall be proportioned for both strength and rigidity; it shall be turned, where necessary, concentric with the axis, and faced on the bottom truly at right-angles to same. It shall be securely anchored to the masonry.

Pivot and Discs.

124. The pivot casting shall be of steel or iron, and shall be supported upon three discs: one of phosphor-bronze between two of hard tool-steel, so designed that the tool-steel will rotate on the phosphor-bronze. The steel discs shall be oil-tempered; and all shall be turned or ground accurately and finished to a high polish. The pivot and discs shall be effectually held, laterally, to resist the specified wind-force of the bridge while swinging, without depending upon the strength of bolts in shear; and provision shall be made for their removal, without jacking-up the structure more than is necessary to take off the load.

End-Lifts.

125. Swing-bridges shall be provided with effective end-lifts, capable of exerting an upward force exceeding the maximum negative live-load reaction by at least 25%, and having a bearing capacity equal to the maximum positive reaction. Where wedges are used in this connection, the actuating mechanism shall be non-reversible and of sufficient strength to prevent the wedges from backing out, no allowance being made for frictional resistance on wedge surfaces.

Latches.

126. There shall be a stong latch at each end of every swing-bridge, designed to close automatically, and so that it may be easily released. When there are guard-piers, additional latch-catches shall be provided thereon to secure the bridge when open.

Stresses for Bascule Bridges.

127. In computing the stresses for bascule-bridges, the following conditions or cases of loading shall be considered:—

Case I. Dead-load, bridge closed;

Case II. Dead-load, bridge in any position which may give maximum stresses of tension and compression in every member;

Case III. Wind-load of 30 lbs. per square-foot on the vertical projection of all exposed surfaces of the entire structure, acting in any horizontal direction and at any period during the operation of the bridge.

Case IV. Live-load on closed bridge, placed so as to give maximum stresses of tension and compression in every member.

128. The following combinations of stresses shall be considered; and the various members shall be proportioned for that combination which requires the greatest section:—

Case I with Case IV, including impact for motor-truck or electric-car loads only, and the specified increase on account of alternate stresses due thereto;

Case II, plus 25% for impact, and increased for alternate stresses as herein specified;

Case II with Case III, no impact and no consideration for alternate stresses.

Counterweight Supports.

129. Steel towers and other parts of the structure which support the counterweight shall be proportioned to resist, in addition to the vertical loads thereon, a horizontal force, in any direction, equal to the specified wind-load; or equal to 5% of the supported load, applied at its centre of gravity.

Counterweight Reinforcing.

130. In proportioning reinforcing members, embedded in the counterweight for supporting or transferring the load to the main structure, provision shall be made for reversals of stress as specified for alternate dead-load, stresses, together with an impact allowance of 25%.

Other Types of Movable Bridges.

131. The stresses for other types of movable bridges shall be computed for the various conditions of loading incident thereto: and the members thereof shall be proportioned for combinations of stresses, generally in accordance with conditions herein governing the design of fixed, swing and bascule bridges, or as may be specified by the engineer.

Toothed Gearing.

132. Gears may be of steel, cast-iron or bronze; they shall preferably have machine-cut teeth of the standard fitfeen-degree involute type, with addendum equal to 0.318 and dedendum equal to 0.368 of the circular pitch. The teeth shall be designed on the assumption that the entire load is taken by one tooth, applied at the end thereof and uniformly distributed throughout its length. The face of cut gears shall not exceed five times and, of uncut gears, three times the circular pitch. For rack and pinion gearing and similar cases, special forms of teeth, designed to secure greater strength, may be used.

Worm-Gearing.

133. In worm-gearing, the worm and wheel shall be made of different metals; generally, the former shall be of steel and the latter of phosphor-bronze or cast-iron. Worm-gearing shall be cut; and the strength of the teeth of the wheel shall be computed in the same manner as for ordinary toothed gearing. In all cases, special provision shall be made for lubrication, by enclosing both worm and wheel in a tight casing, preferably cast with the bearings, and with provision for an oil-bath for either the worm or wheel.

Shafting.

134. Shafting may be of cold-rolled, bar or forged steel. Line shafting shall not be less than one and fifteen-sixteenths inches in diameter; and the bearings for same shall be spaced not over sixty diameters apart. All gearing, couplings or other attachments shall be close to bearings. Shafting shall be designed for combined bending and torsion, in accordance with the formula for equivalent bending-moment, herewith:—

$$M_1 = \tfrac{1}{2}\left(M + \sqrt{M^2 + T^2}\right);$$

in which M_1=equivalent bending moment;
M =bending-moment;
T =twisting-moment, or torque.

135. Provision shall be made for the weakening effect of keyways, assuming that one keyway, or two keyways at right-angles to one-another, will reduce the section-modulus of the shaft, in bending, to 83% of its original value; and that two keyways opposite one-another will reduce this section-modulus to 75%. At all points where the diameter of a shaft is changed, a fillet, as large as possible, shall be used.

Collars.

136. Effectual means for preventing longitudinal movement of shafting shall be provided, such as a split collar clamped in a cut groove, or a substantial pin or bolt passing through a collar or through the hub of an attached part. Collars with set-screws may be used only in case there is no definite longitudinal force to be resisted.

Keys.

137. All parts transmitting torsion to shafts shall be fastened thereto by keys. The width of keys shall be approximately one-fourth of the diameter of the shaft; and their thickness, about two-thirds of their width;

they shall be tapered ⅛ inch to a foot, and shall be provided with gib-heads wherever possible. When two keys are used, they shall not be placed opposite one-another.

Bearings.

138. Bearings, generally, shall be of cast-iron, except where steel is required for strength. All steel bearings, and cast-iron bearings subject to heavy duty or fast-running shafts, shall be babbitted, or lined with some other suitable material, preferably bronze.

Axles.

139. Axles for balance-wheels shall either be fixed in the wheel and turn in the bearings; or fixed in the bearings, with the wheel turning. In the latter case, the hub of the wheel shall be of such length that a normal to the wheel-tread, at any point, will fall well within the limits of the rotating bearing on the axle.

Set-screws.

140. Set-screws and tap-bolts shall not be used for any important fastening.

Operating Power.

141. Movable bridges may be operated by hand-power only, or by both hand and mechanical power, depending upon local conditions, and as specified by the engineer.

Hand-power.

142. In the case of hand-power, the number of men and the time required to operate the bridge shall be estimated on the assumption that one man will push 40 lbs. on the turning-lever while walking at a speed of 160 feet per minute. In proportioning the machinery parts, it shall be assumed that there will be at least two men on each handle of the turning-lever, pushing 75 lbs. each.

Mechanical Power.

143. If the bridge is to be opereated by mechanical power, the motor shall be of ample capacity to perform its duty at the required speed. All machinery parts, including connections and supports therefor, shall be proportioned, at the specified unit-stresses, for the rated power of the motor, increased by 100% for impact. No matter what mechanical power may be used, all movable bridges shall also be provided with hand-power operating machinery. The arrangement and details of the machinery, construction and location of the operator's cabin, and any other details connected with the mechanical operating power, shall be subject to the approval of the engineer.

144. The contractor shall in all cases supply the engineer with the performance-curve of the motor to be used. In the case of electric-power, a direct-current motor of 220 volts shall be given preference; although a polyphase alternating-current motor, of the wound rotor type and of not over 550 volts, may be used. All electric motors shall be provided with safety devices, designed to prevent excessive over-loading; and the entire electrical equipment shall be installed in accordance with requirements of the authorities having jurisdiction in such matters. When steam-power is used, the contractor shall supply the engineer or owner with such certificates of inspection as may be required by the local authorities. In all cases, the motor, of whatever form, shall be of a well-known make.

Operating Machinery.

145. The operating machinery of movable bridges shall be designed and constructed in a substantial manner, and shall be free from complicated and flimsy contrivances. All parts shall be arranged so that they may be easily erected, adjusted and taken apart; and they shall be accessible for inspection, cleaning and repairs. Fastenings shall be designed so that, when all machinery parts are properly set, lined and adjusted, they will be permanently fixed.

146. In the case of swing-bridges, the operating machinery shall be capable of holding the structure, or of operating it, at a reduced speed, under an unbalanced wind-pressure of 5 lbs. per square-foot, acting upon the vertical projection of all exposed surfaces of one arm only. When the arms are of equal length, the machinery shall be arranged for making a complete revolution of the bridge in either direction. Hand-power machinery shall be arranged so that the lever for operating the end-lifts and for swinging the bridge will be applied as near the centre pivot as practicable. Keyholes in the floor, for applying the operating-lever, shall be provided with suitable cast-iron or steel covers.

147. When mechanical power is used, the operating-machinery shall be provided with effective brakes, to hold the bridge against the specified wind-load, or to bring it to rest in the time allowed in the calculations. In estimating the effect of the brake on all parts of the mechanism, including the rack and members of the structure to which machinery is attached, frictional resistances which assist the brake shall be added, using maximum values. In determining the loss of power due to friction, the efficiency of cut-gears shall be taken at 98%; of uncut gears, 85%; the coefficient of friction for journals shall be taken at 10%; for wedges, 15% on the top surface and 20% on the bottom.

Unit-Stresses, Machinery Parts.

148. Machinery parts shall be designed in accordance with the permissible unit-stresses given in Table I. below, in lbs. per square-inch.

TABLE I. UNIT-STRESSES, MACHINERY PARTS

Kind of Stress	Structural Steel	Rolled Steel Shafting	Forged Steel Shafting	Steel Castings	Iron Castings	Brass
Axial Tension	16,000	16,000	20,000	12,000	....	......
Direct Compression	14,000	14,000	17,500	14,000	10,000	3,000
Bending....	16,000	12,000	15,000	12,000	3,000	3,000
Shear......	10,000	10,000	12,000	10,000	3,000	3,000

Strenth of Gear-Teeth.

149. The strength of fifteen-degree involute gear-teeth shall be determined by the formulæ below. Unit-stresses for speeds between those given to be obtained by interpolation. Other forms of gear-teeth shall be proportioned so that their maximum fibre-stress in bending will not exceed the unit-stresses given in Tables II and III.

$P = s\ p\ f\ y$, for plain gears;

$P = s\ p\ f\ y\ \frac{d}{D,}$ for bevel gears;

in which P=maximum load on tooth, in pounds;
s=unit-stress for bending, as given in Tables II and III;
p=pitch of teeth, in inches;
f=face of tooth, in inches;
y=strength-factor, depending upon the form of the tooth, as given in Table IV;
d=small pitch-diameter of a bevel-gear;
D=large pitch-diameter of same bevel-gear.

TABLE II. UNIT-STRESSES s FOR CAST-IRON AND BRONZE GEAR-TEETH

	Speed of teeth, in feet per minute.							
	100 or less	200	300	600	900	1,200	1,800	2,400
Cut Teeth.	8,000	6,000	4,800	4,000	3,000	2,400	2,000	1,700
Cast teeth..	4,000	3,000	2,400	....	....	....	....	....

TABLE III. UNIT-STRESSES s FOR STEEL GEAR-TEETH

	Speed of teeth, in feet per minute.							
	100 or less	200	300	600	900	1,200	1,800	2,400
Cut Teeth..	20,000	15,000	12,000	10,000	7,500	6,000	5,500	4,300
Cast Teeth.	10,000	7,500	6,000	......	......	......	......	......

TABLE IV. STRENGTH-FACTOR y FOR FIFTEEN-DEGREE INVOLUTE TEETH

No. of Teeth	Factor	No. of Teeth	Factor	No. of Teeth	Factor	No. of Teeth	Factor
12	0.067	18	0.083	27	0.100	60	0.114
13	0.070	19	0.087	30	0.102	75	0.116
14	0.072	20	0.090	34	0.104	100	0.118
15	0.075	21	0.092	38	0.107	150	0.120
16	0.077	23	0.094	43	0.110	300	0.122
17	0.080	25	0.097	50	0.112	Rack.	0.124

Moving Bearings.

150. The maximum bearing-values, in lbs. per square-inch, to be used for rotating and sliding surfaces where the speed is slow and intermittent, are as follows:—

Pivots for swing-bridges, hardened tool-steel on phosphor-bronze	3,000
Trunnion-bearings for bascule-bridges, forged steel on phosphor-bronze	1,200
Wedges, cast-iron on bronze	600
Wedges, cast-iron on cast-iron or steel	500
Screws which transmit motion	100
Steel journals on bronze bushings	1,000
Steel or cast-iron journals on babbitted bushings	700

151. In order to prevent heating and seizing at higher speeds, the pressure per square-inch on pivots, foot-step-bearings for vertical shafts and on journals shall not exceed:—

$$p = \frac{160{,}000,}{n\ d}, \text{ on pivots;}$$

$$p = \frac{300{,}000,}{n\ d}, \text{ on journals;}$$

in which p=pressure per square inch;
n=number of revolutions per minute;
d=diameter of pivot or journal, in inches.

152. For crank-pins and similar parts with alternating motion, the limiting bearing-value, as derived from the above formula for journals, may be doubled; but it shall not exceed the limit herein specified for slow speeds.

Roller-Bearings.

153. The maximum bearing, in lbs. per lineal-inch, on rollers in motion, shall be as follows:—

Cast-iron	200 d
Cast-steel	600 d
Forged steel	750 d
Tool-steel	1,200 d
Hardened tool-steel	1,500 d

in which d = diameter of roller, in inches. The above values are for roller and bearing surfaces of the same material; if of different materials, the lower value shall be used.

Safety Gates.

154. All movable bridges which leave the roadway unprotected when open shall be provided with safety-gates, or with chains, to stop the traffic. When specified by the engineer, the gates shall be arranged so that the bridge cannot be opened before the gates are closed, and so that the gates cannot be opened before the bridge is closed and locked.

Patents.

155. The contractor shall fully indemnify and save harmless the purchaser against all loss or damage, claims and demands, costs and charges, which may arise or accrue by reason of the adoption or use by the contractor of any patented article, device or improvement furnished by him.

WORKMANSHIP.

General.

156. All parts forming a structure shall be built in accordance with approved drawings. The workmanship and finish shall be equal to the best practice in modern bridge works. Material shall have clean surfaces before being worked in the shop.

Straightening.

157. Material shall be thoroughly straightened in the shop, by methods that will not injure it, before being laid off or worked in any way.

Finish.

158. Shearing and chipping shall be neatly and accurately done, and all portions of the work exposed to view shall be neatly finished. When specified by the engineer, sheared edges of all splice and connection plates for main members, and all of material over ⅝-inch thick, shall be planed at least ⅛ inch.

Lattice-bars.

159. Lattice-bars shall have neatly rounded ends, unless otherwise called for.

Rivet-holes.

160. Unless otherwise specified by the engineer, rivet-holes in main members shall either be drilled from the solid, or sub-punched and reamed. In lateral and sway-bracing and in secondary parts, such as tie-plates, lattice-bars, stiffners, etc., rivet-holes may be punched full size.

Punched Holes.

161. Where reaming is not required, the diameter of the punch shall not be more than one-sixteenth (1/16) inch greater than the nominal diameter of the rivet; nor the diameter of the die more than one-eighth (⅛) inch greater than that of the punch. Punching shall be accurately done. Drifting, to enlarge unfair holes, will not be allowed. If holes must be enlarged to admit the rivets, they shall be reamed. Poor matching of holes will be cause for rejection.

Reamed Holes.

162. In the case of sub-punching and reaming, the diameter of the punch shall be not less than three-sixteenths (3/16) inch smaller than the nominal diameter of the rivet; and the holes shall be reamed to a diameter not more than one-sixteenth (1/16) inch greater than the nominal diameter of the rivet. The holes, before being reamed, shall match with sufficient accuracy so that at least one-sixteenth (1/16) inch of metal will be removed from the die-side thereof. Reaming shall be done with twist drills and without using any lubricant. the outside burrs on reamed holes shall be removed.

Drilled Holes.

163. Holes in steel of greater thickness than ¾ inch shall be drilled from the solid; likewise holes in flanges of rolled beams and channels used in bending, except when situated in the unstressed ends. Outside burrs shall be removed.

Field Connections.

164. All field connections, except those for lateral and sway-bracing, shall be reamed to approved steel template; otherwise the members shall be assembled in the shop and then reamed.

Assembling.

165. The several pieces forming one built member shall be straight; and they shall be firmly drawn together with sufficient bolts, so that the pieces will fit closely. Contact surfaces shall be painted or oiled. The finished member shall be free from twists, bends or open joints.

Web-Stiffeners.

166. Web-stiffeners shall fit neatly between the flanges of girders. When not otherwise specified, the ends of the stiffeners shall be faced to make true contact bearings with the flange-angles.

Splice-Plates and Fillers.

167. Web splice-plates and fillers under stiffeners shall be cut to fit within ¼ inch of the flange-angles.

Floorbeams and Stringers.

168. Connection-angles for floorbeams and stringers shall be set truly square and to the exact lengths called for on the drawings. When specified by the engineer, the main sections of floorbeams and stringers shall be milled to exact length, after the flanges have been rivetted, and the connection-angles shall be set flush with and true to the milled ends; or the connection-angles may first be rivetted to the girder or beam, and the entire end surfaces milled. The minimum thickness of the connection-angles, after milling, shall be ⅜ inch.

Size of Rivets.

169. The size of rivets, called for on the plans, shall be understood to mean their actual size before heating.

Rivetting.

170. Rivets shall be uniformly heated to a light cherry red heat; and they shall be driven by pressure tools wherever possible. Pneumatic hammers shall be used for field rivetting in preference to other hand tools.

Rivet Finish.

171. Rivets shall look neat and finished, with heads of approved shape, full and of equal size. They shall be central on the shank, and shall grip the assembled pieces firmly. Recupping and caulking will not be allowed. Loose, burnt or otherwise defective rivets shall be cut out and replaced. In cutting out rivets, great care shall be taken not to injure the adjacent metal; if necessary, they shall be drilled out.

Turned-Bolts.

172. Wherever bolts are used in place of rivets which transmit shear, the holes shall be reamed parallel, and the turned-bolts shall make a driving fit, with the thread entirely outside of the hole. A washer, not less than ¼ inch thick, shall be used under both head and nut.

Eye-Bars.

173. Eye-bars shall be straight and true to size, and shall be free from twists, folds in the neck or head, or any other defect. Heads shall be made by upsetting,

rolling or forging. Welding will not be allowed. The form of the heads may be determined by the dies in use at the works where the eye-bars are to be made, if satisfactory to the engineer; but the manufacturer shall guarantee the bars to break in the body when tested to rupture. The thickness of head and neck shall not vary more than 1/16 inch from that specified.

Boring Eye-Bars.

174. Before boring, each eye-bar shall be properly annealed and carefully straightened. Pin-holes shall be on the centre-line of the eye-bar and in the centre of the heads. Bars of the same length shall be bored so accurately that, when placed together, pins 1/32 inch smaller in diameter than the pin-holes can be passed through the holes at both ends of the bars, at the same time and without forcing.

Pin-Holes.

175. Pin-holes shall be bored true to gauge, smooth and straight; at right-angles to the axis of the member, and parallel to each other, unless otherwise called for. The boring shall be done after the member has been rivetted up.

176. The distance centre to centre of pin-holes shall be correct within 1/32 inch; the diameter of the holes shall not be more than 1/50 inch larger than that of the pin, for pins up to 5 inches in diameter; and 1/32 inch, for larger pins.

Pilot-Nuts.

177. Pilot and driving nuts shall be furnished for each size of pin.

Pins and Rollers.

178. Pins and rollers shall be accurately turned to gauge; they shall be straight and smooth and entirely free from flaws.

Screw-Threads.

179. Screw-threads shall make tight fits in the nuts; when over 1⅜ inches in diameter, they shall be made with six threads per inch.

Bed-Plates.

180. Expansion bed-plates shall be planed and true smooth. Cast bed-plates shall be planed top and bottom. The finishing-cut of the planing tool shall be fine, and shall be parallel to the direction of the expansion.

Annealing.

181. Excepting minor details, steel which has been partially heated shall be properly annealed.

Castings.

182. Castings shall be free from large or injurious blow-holes; and steel castings shall be annealed.

Welds.

183. Welds in steel will not be allowed.

MATERIALS.

Steel.

184. Steel shall be made by the open-hearth process.

Properties.

185. The chemical and physical properties of steel shall conform to the following limits:—

Elements Considered	Structural Steel	Rivet Steel	Forged Steel	Steel Castings
Phosphorus, max. (basic)	0.04%	0.04%	0.04%	0.05%
Phosphorus, max. (acid)	0.06%	0.04%	0.06%	0.08%
Sulphur, max	0.05%	0.04%	0.05%	0.05%

Ultimate Tensile Strength, lbs. per square-inch:
Structural Steel.............60,000, desired;
Rivet Steel.................50,000, desired;
Forged Steel................80,000, desired;
Steel Castings..............65,000, minimum.

Elongation, minimum percentage in 8 inches, Fig. 1:
Structural Steel, Rivet Steel, Forged Steel: $\dfrac{1{,}500{,}000}{\text{Ultimate Tensile Strength}}$

Elongation, minimum percentage in 2 inches, Fig. 2:
Structural Steel....................22;
Forged Steel.......................20;
Steel Castings.....................15.

Character of Fracture:
Structural Steel, Rivet Steel, Forged Steel: silky;
Steel Castings....silky or fine granular.

Cold Bends without Fracture:
Structural Steel, Rivet Steel, Forged Steel: 180° flat;
Steel Castings....90°, $d=3t$;

in which d = diameter of pin,
t = thickness of specimen.

Yield-Point.

186. The yield-point, as indicated by the drop of beam, shall be recorded in the test reports.

Eye-Bar Specimen Tests.

187. In order that the ultimate strength of full-sized annealed eye-bars shall meet the requirements hereinafter specified, the ultimate strength in test-specimens may be determined by the manufacturer; but all other tests than those for ultimate strength shall conform to the above requirements.

Allowable Variations.

188. If the ultimate strength varies more than 4,000 lbs. from that desired, a retest shall be made on the same gauge, which, to be acceptable, shall be within 5,000 lbs. of the desired ultimate.

Chemical Analyses.

189. Chemical determination of the percentages of carbon, phosphorus, sulphur and manganese shall be made by the manufacturer from a test-ingot taken at the time of pouring of each melt of steel; and a correct copy of

such analysis shall be furnished to the engineer or his inspector. Check-analyses shall be made from finished materials, if called for by the purchaser; in which case an excess of 25% above the required limits will be permitted.

Specimens.

190. Plate, shape and bar specimens for tensile and bending tests shall be made by cutting coupons from the finished product, which shall have both faces rolled and both edges milled to the form shewn by Fig. 1; or both edges parallel; or they may be turned to a diameter of ¾ inch for a length of at least 9 inches, with enlarged ends.

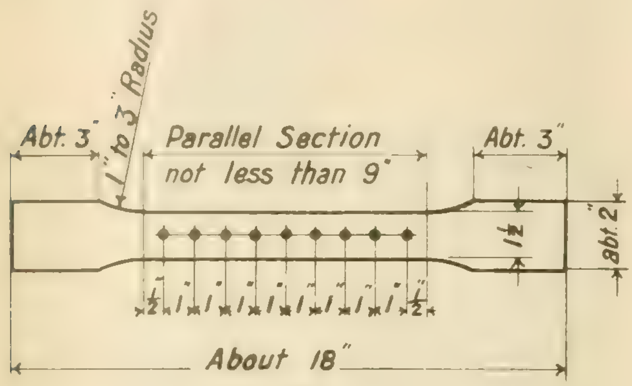


Fig. 1.

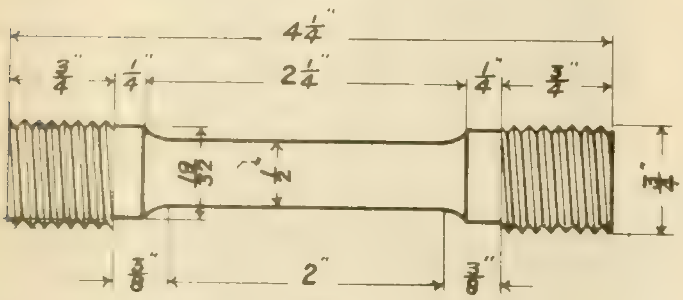


Fig. 2.

Rivet-Rods.

191. Rivet-Rods shall be tested as rolled.

Pin and Roller Tests.

192. Pin and roller specimens shall be cut from the finished rolled or forged bar, in such manner that the centre of the specimen shall be one inch from the surface of the bar. The specimen for tensile strength shall be turned to the form shewn by Fig. 2. The specimen for bending test shall be one inch by one-half inch in section.

Steel Casting Tests.

193. For steel castings, the number of tests will depend on the character and importance of the castings. Specimens shall be cut cold from coupons moulded and cast on some portion of one or more castings from each melt; or from sink-heads, if the latter are of sufficient size. The coupon or sink-head so used shall be annealed with the casting before it is cut off. Test-specimens shall be of the form prescribed for pins and rollers.

Specimens of Rolled Steel.

194. Rolled steel shall be tested in the condition in which it comes from the rolls.

Number of Tests.

195. At least one tensile and one bending test shall be made from each melt of steel as rolled. In case steel differing ⅜ inch and more in thickness is rolled from one melt, a test shall be made from the thickest and thinnest material rolled.

Modification in Elongation.

196. A deduction of one per cent. (1%) will be allowed from the specified percentage for elongation, for each ⅛ inch in thickness above ¾ inch.

Bending-Tests.

197. Bending-tests may be made by pressure or by blows. Plates, shapes and bars less than one inch thick shall bend as called for in table of properties, above. Specimen-tests 2½ inches wide of full-sized material for eye-bars, and other steel one inch thick and over, tested as rolled, shall bend cold 180° around a pin, the diameter of which is equal to twice the thickness of the bar, without fracture on the outside of bend.

Bending Angles.

198. Angles of all thicknesses shall open cold to an included angle of 150°, and close to an angle of 30°, without sign of fracture.

Nicked Bends.

199. Rivet steel, when nicked and bent around a bar of the same diameter as that of the rivet rod, shall give a gradual break and a fine silky uniform fracture.

Finish.

200. Finished material shall be free from injurious seams, flaws, cracks, defective edges or other defects; and shall have a smooth, uniform and workmanlike finish. Plates, 36 inches in width and under, shall have rolled edges.

Melt-Numbers.

201. Every finished piece of steel shall have the melt-number and the name of the manufacturer stamped or rolled upon it. Steel for pins and rollers shall be stamped on the end. Rivet and lattice steel and other small parts may be bundled with the above marks on an attached metal tag.

Defective Material.

202. Material which, subsequent to the above tests at the mills and its acceptance there, develops weak spots, brittleness, cracks or other imperfections, or is found to have injurious defects, will be rejected at the shop, and shall be replaced by the manufacturer at his own cost.

Variation in Weight.

203. A variation in cross-section or weight of each piece of steel of more than 2½% from that specified shall be sufficient cause for rejection; except in the case of sheared plates, which shall be covered by the following permissible variations, which apply to single plates, when ordered to weight:—

Plates, 12½ lbs. per square foot or heavier:—

(a) Up to 100 inches wide, 2½% above or below the prescribed weight.

(b) 100 inches wide and over, 5% above or below.

Plates under 12½ lbs. per square foot:—

(a) Up to 75 inches wide, 2½% above or below.

(b) 75 inches wide and up to 100 inches wide, 5% above or 3% below.

(c) 100 inches wide and over, 10% above or 3% below.

204. Plates, when ordered to gauge, will be accepted if they measure not more than 0.01 inch below the ordered thickness.

205. An excess over the nominal weight, corresponding to the dimensions on the order, will be allowed for each plate, if not more than that shewn in the following table, one cubic inch of rolled steel being assumed to weight 0.2833 lb.:—

Thickness Ordered.	Nominal Weights.	Width of Plate			
		Up to 75 ins.	75 to 100 ins.	100 to 115 ins.	Over 115 ins.
¼ in......	10.20 lbs.	10%	14%	18%	...
5/16 in..........	12.75 lbs.	8%	12%	16%	...
⅜ in......	15.30 lbs.	7%	10%	13%	17%
7/16 in..........	17.85 lbs.	6%	8%	10%	13%
½ in......	20.40 lbs.	5%	7%	9%	12%
9/16 in..........	22.95 lbs.	4½%	6½%	8½%	11%
⅝ in......	25.50 lbs.	4%	6%	8%	10%
Over ⅝ in.......	..	3½%	5%	6½%	9%

Cast-Iron.

206. Except where chilled iron is specified, castings shall be made of tough grey iron, with sulphur not over 0.10 per cent. They shall be true to pattern, out of wind and free from flaws and excessive shrinkage. If tests are demanded, they shall be made on the "Abritration Bar" of the American Society for Testing Materials, which is a round bar 1¼ inches in diameter and 15 inches long. The transverse test shall be made on a supported length with load at middle. The minimum breaking-load so applied shall be 2,900 lbs., with a deflection of at least 1/10 inch before rupture.

Wrought-Iron.

207. Wrought-iron shall be double-rolled, tough, fibrous and uniform in character. It shall be thoroughly welded in rolling, and shall be free from surface defects. When tested in specimens of the form of Fig. I, or in full-sized pieces of the same length, it shall shew an ultimate strength of at least 50,000 lbs. per square inch, an elongation of at least 18 per cent. in 8 inches, with fracture wholly fibrous. Specimens shall bend cold, with the fibre, through 135 degrees, without sign of fracture, around a pin the diameter of which is not over twice the thickness of the piece tested. When nicked and bent, the fracture shall shew at least 90 per cent. fibrous.

Tool-Steel.

209. Tool-steel shall be used generally for parts which require hardening or oil-tempering, such as pivots, friction-rollers, ball-bearings and springs.

209. Tool-steel shall be made by the open-hearth or crucible process; and its chemical properties shall be as follows:—

Carbon................	1.00% minimum;
Phosphorus............	0.04% maximum;
Sulphur................	0.04% maximum;
Manganese.............	0.50% maximum.

Phosphor-Bronze, for Bushings and Discs.

210. Special phosphor-bronze shall be used for high pressures with low speed. The metal shall have a minimum elastic-limit in compression of 24,000 lbs. per square inch. Test-pieces shall be one-inch cubes, finished; and they shall be cut from coupons, moulded and cast on some portion of each casting. The composition of phosphor-bronze shall be as follows:—

Copper........................	80.0%;
Tin...........................	10.0%;
Lead..........................	9.5%;
Phosphorus....................	0.5%.

Babbitt-Metal.

211. The composition of babbitt-metal shall be as follows:—

Tin...........................	86.0%;
Copper........................	6.0%;
Antimony......................	8.0%.

Timber.

212. Timber may be oak, southern long-leaf pine, Douglas-fir, white, red or Norway pine, spruce or birch; and, unless otherwise specified, it shall be of the grade known as *merchantable.*

FULL-SIZED TESTS.

Eye-Bar Tests.

213. When specified by the engineer, full-sized tests on eye-bars and similar members, to the extent of at least 2% of the number required, shall be made at the manufacturer's expense. If these tests do not meet the requirements herein specified, all members represented thereby will be rejected.

214. In eye-bar tests, the minimum ultimate strength shall be 55,000 lbs. per square-inch. The elongation in 10 feet, including fracture, shall not be less than 15%. Bars shall generally break in the body, and the fracture shall be silky or fine granular; the elastic-limit, as indicated by the drop of the mercury, shall be recorded. Should a bar break in the head yet develop the specified elongation, utimate strength and character of fracture, it will not be rejected, provided not more than one-third of the total number of bars tested fail in this manner.

INSPECTION AND TESTING AT THE MILLS.

Mill-Orders.

215. The purchaser shall be furnished complete copies of mill-orders; and no material shall be rolled nor work done before the purchaser has been notified where the orders have been placed, so that he may arrange for the inspection.

Facilities for Inspection.

216. The contractor shall furnish all facilities for the inspecting and testing of all material at the mill where it is to be manufactured. He shall furnish a suitable testing-machine for testing the specimens, as well as prepare the pieces for the machine, free of cost.

Access to Mills.

217. When an inspector is furnished by the purchaser to inspect material at the mills, he shall have full access, at all times, to all parts of the mills where material to be inspected by him is being manufactured.

INSPECTION AND TESTING AT THE SHOPS.

Facilities for Inspection.

218. The contractor shall furnish all facilities for inspecting and testing the quality of workmanship at the shop where the material is to be fabricated.

Starting Work.

219. The purchaser shall be notified well in advance of the start of the work in the shop, in order that he may have an inspector on hand to inspect material and workmanship.

Access to Shops.

220. When an inspector is furnished by the purchaser, he shall have full access, at all times, to all parts of the shop where material under his inspection is being fabricated.

Accepting Material.

221. The inspector shall stamp each piece accepted with a private mark. Any piece not so marked may be rejected at any time and at any stage of the work. If the inspector, through an oversight or otherwise, has accepted material or work which is defective or contrary to the specification, such material or work, no matter in what stage of manufacture may be rejected by the purchaser.

Shop-Plans.

222. The purchaser shall be furnished complete shop-plans.

Shipping-Invoices.

223. Complete copies of shipping-invoices shall be furnished to the purchaser with each shipment. These shall shew the scale-weights of individual pieces.

PAINTING, CREOSOTING AND ASPHALT.

Metal Cleaned.

224. Before painting, all metal surfaces shall be thoroughly scraped and cleaned of rust, scales or dust, either with the sand-blast, steel scrapers or stiff wire brushes; finally, the surfaces shall be dusted off with a stiff bristle brush.

Shop-Coat of Paint.

225. Unless otherwise required by the engineer, the paint for shop primming-coat shall be pure red-lead and lampblack, mixed with pure boiled linseed oil, in the following proportions: red-lead, 25 lbs.; lampblack, 4 ozs.; boiled linseed oil, one gal. It shall not be thinned with turpentine, benzine or other liquids, and no drier will be allowed. The red-lead and lampblack shall be mixed dry, the oil added, and the mixture stirred to a uniform consistency and applied at once. Only a sufficient quantity for immediate use shall be mixed at one time.

Inaccessible Surfaces.

226. All surfaces inaccessible after erection, including top surfaces of stringers, eye-bar heads, ends of posts, chords, etc., shall have two coats of paint in the shop. All planed and turned surfaces shall be cleaned and coated with white-lead, mixed with tallow, before leaving the shop.

Field-Coats of Paint.

227. The structure shall be given two field-coats of approved paint after erection. These coats shall preferably be of different colours, in order that they may be readily distinguished.

Metal Cleaned after Erection.

228. After the erection of the structure, all rust spots shall be thoroughly cleaned; and, where the paint has been rubbed off, it shall be repainted. All rivet-heads, bolt-heads and nuts, which have been placed in the field, shall be given a coat of the shop-paint before the field-coats are applied.

Wet Weather.

229. No painting will be allowed in wet or freezing weather. Painting shall be done by skilled workmen.

Creosoting.

230. Timber to be creosoted shall be thoroughly seasoned, at a temperature not exceeding two hundred and thirty (230) degrees, Fahrenheit, in a vacuum of twenty-four (24) inches of mercury; and not less than (10) lbs. of heavy creosote oil to each cubic foot of timber shall be forced into the timber, under a pressure of not less than one-hundred and fifty (150) lbs. per square inch.

Creosote Oil.

231. Creosote oil shall contain not less than five (5) per cent. of otar acids, and not less than twenty-five (25) per cent. of ingredients that do not distill over a temperature of six hundred (600) degrees, Fahrenheit. It shall,

generally, be solid at a temperature of one hundred (100) degrees, Fahrenheit. It shall be free from water, ammonia, naphtha and any other impurities.

Quality of Asphalt.

232. Asphalt shall be of the best quality, free from coal-tar and its products; it shall not volatilise more than one-half (½) of one per cent. under a temperature of three hundred (300) degrees, Fahrenheit, for ten (10) hours.

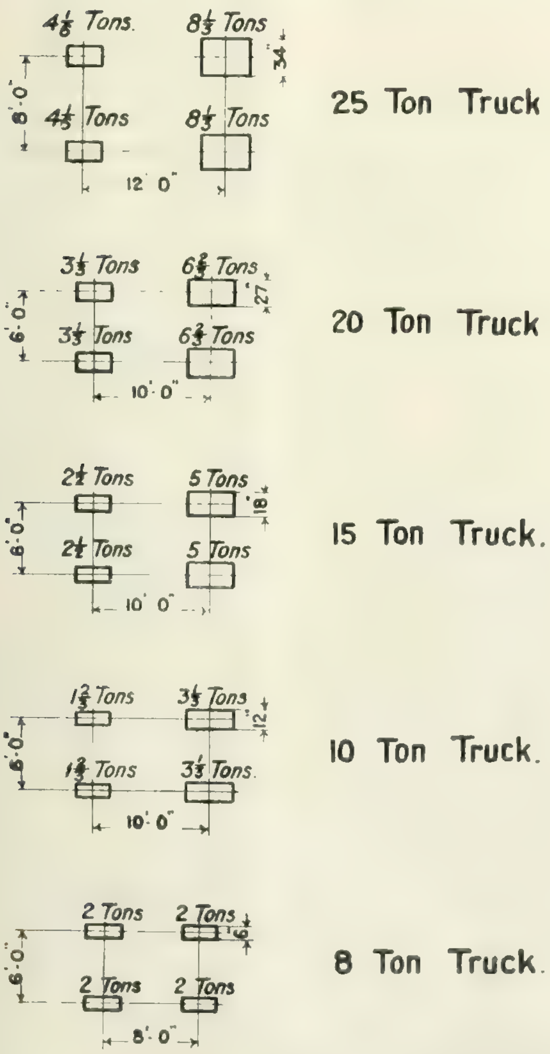
233. For under-ground structures, a flow-point of one hundred and eighty-five (185) degrees, Fahrenheit, and a brittle-point of six (6) degrees, Fahrenheit, below zero, will be required.

COMMITTEE

P. B. Motley, *Chairman*	J. G. Legrand
H. B. Stuart	Geo. W. Craig.
H. P. Borden	F. D. Cole
F. P. Shearwood	E. G. W. Montgomery
G. H. Duggan	H. A. Icke
A. E. Johnson	M. A. Lyons
W. Chase Thomson, *Secretary*	A. H. Harkness
W. A. Bowden	C. N. Monsarrat, *Lt.-Col.*

Appendix I.

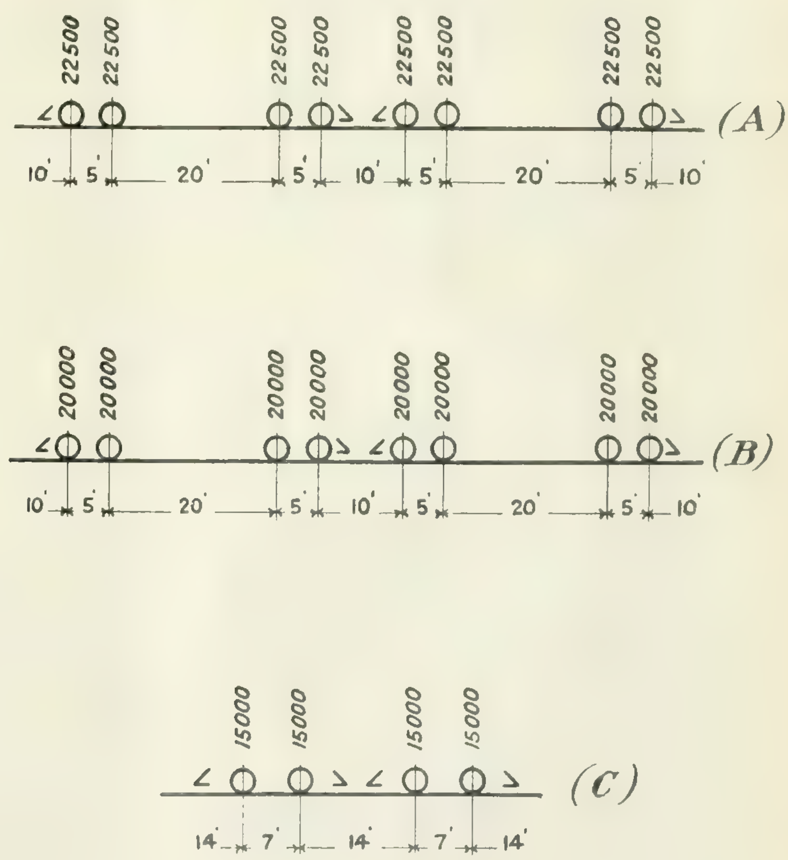
MOTOR-TRUCK LOADS.



NOTE:-One Ton = 2000 lbs.

Appendix II.

ELECTRIC-CAR LOADS.



NOTE:- All loads are given in lbs. per axle.

APPENDIX III.

SHEARING AND BEARING VALUES OF SHOP RIVETS

Diam of Rivet	Single Shear at 11,000 lb. per sq. in.	Bearing Value for different thicknesses of Plate at 22,000 lbs. per square inch.												
		1/4″	5/16″	3/8″	7/16″	1/2″	9/16″	5/8″	11/16″	3/4″	13/16″	7/8″	15/16″	1″
3/8″	1,210	2,060	2,580	3,090										
1/2″	2,160	2,750	3,440	4,130	4,820	5,500								
5/8″	3,370	3,440	4,300	5,160	6,020	6,880	7,740	8,600						
3/4″	4,860	4,130	5,160	6,190	7,220	8,250	9,280	10,320	11,340	12,380				
7/8″	6,610	4,810	6,020	7,220	8,430	9,630	10,840	12,040	13,240	14,440	15,640	16,840	18,050	
1″	8,640	5,500	6,880	8,250	9,630	11,000	12,380	13,750	15,130	16,500	17,880	19,250	20,630	22,000

SHEARING AND BEARING VALUES OF FIELD RIVETS

Diam. of Rivet	Single Shear at 10,000 lb. per sq. in.	Bearing Value for different thicknesses of Plate at 22,000 lbs. per square inch.												
		1/4″	5/16″	3/8″	7/16″	1/2″	9/16″	5/8″	11/16″	3/4″	13/16″	7/8″	15/16″	1″
3/8″	1,100	1,880	2,340	2,810										
1/2″	1,960	2,500	3,130	3,750	4,380	5,000								
5/8″	3,070	3,130	3,910	4,690	5,470	6,250	7,030	7,810						
3/4″	4,420	3,750	4,690	5,630	6,560	7,500	8,440	9,380	10,310	11,250				
7/8″	6,010	4,380	5,470	6,570	7,660	8,750	9,840	10,940	12,030	13,130	14,220	15,310	16,410	
1″	7,850	5,000	6,250	7,500	8,750	10,000	11,250	12,500	13,750	15,000	16,250	12,750	18,750	20,000

All bearing values or to right of upper zig-zag lines are greater than double shear. Values between upper and lower zig-zag lines are less than double and greater than single shear.

Values below and to left of lower zig-zag lines are less than single shear.

For hand driven rivets and turned bolts reduce above values for field rivets by 20%.

APPENDIX IV.

DATA TO BE SUPPLIED BY THE PURCHASER'S ENGINEER.

1. Location of proposed bridge, and general description of site.
2. Type of movable bridge, if any.
3. Plan and profile of bridge-site, giving elevations of floor-line and of high and low water, speed of current and character of bottom.
4. Diagram of abutments and piers (if built) shewing their location, and giving elevations and dimensions of bridge-seats.
5. Clear width of roadway.
6. Number and location of street-car tracks, if any.
7. Type of floor for roadway and sidewalks.
8. Number and width of sidewalks, if any.
9. Whether steel or timber stringers are to be used.
10. Type of hand-railing for roadway or sidewalks.
11. If a timber floor is specified, the kind of timber required, and whether provision shall be made to carry a future permanent floor.
12. Class of uniform live-load required, (see paragraphs 20, 21 and 22).
13. Motor-truck loads to be used, (see appendix I).
14. Electric-car loads, if any, (see appendix II).
15. Whether uniform live-load on sidewalks is to be considered in designing the trusses or main girders, (see paragraph 28).
16. Minimum thickness of metal allowed, (see paragraph 55).
17. Whether main members are to be reamed, (see paragraph 160).
18. Whether full-sized tests of eye-bars are required.
19. In the case of a movable bridge, whether it is to be operated by electric-motor, steam-engine, gasoline-engine, or by hand-power only.
20. Clear width of waterway and clear height above water, when a movable bridge is open.
21. Whether automatic gates or chains shall be provided to protect roadway when a movable bridge is open.
22. Kind of paint required for field-coats.

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Conscription and the Engineer

Many are the occasions on which we have been told, by press and pulpit, by publicist and politician, that this is an engineering age, and that the Great War is being fought and will be won or lost by engineers and scientists. Few there be who will take issue with this statement. Not alone is engineering knowledge and experience essential to success in our operations and in the prosecution of the war. Such knowledge and experience must likewise be dominant in affairs of organization and administration, in matters military as in the affairs of civil life.

In the early days of the war, before the significance of the struggle was understood, no one of us experienced either surprise or abhorrence when we learned of military preferment on the basis of political control or family connection. In these days of strain and stress we are just beginning to realize the great sacrifices of life and material which have come about almost directly through the most unaccountable stupidity of our nation, in tolerating for so long the control of politicians in the administration of public affairs, and more particularly in the control of matters relating to the war. Individually we effervesce and boil, but collectively we are inactive and supine.

Disturbing rumors have come to our ears from time to time of late with respect to preferment in military appointments, and these should be investigated. Time and again we have been told of responsible appointments in Engineering corps being given to the less qualified, while the more experienced are passed by . To be more specific, we hear of men of the legal profession, without administrative or engineering training of any kind, being appointed as Engineer officers, while trained men of the engineering profession, men of affairs, men who have had charge of operations, who have had supervision of workers, and have had superior training in engineering, are left in the ranks.

These rumors necessarily force on us the query as to what is being done with the trained engineers, chemists, and other scientists who come under the draft. Only a few days ago we learned of a trained chemist and physicist, a Doctor in Philosohy of an American University, and Canadian in essential employment in the Government service in Ottawa, who has been drafted. And we are told that chemists cannot be secured to carry on the work of munition manufacture and to perform the work of essential industries in this country. Is this man, are these men, being dumped into the great body of recruits without selection and without classification? Are they being placed in positions where their training and experience can be utilized? Recent inquiries lead us to believe that these highly trained men are being *neither sought out nor utilized.*

Our prosperity and success after the war, the rehabilitation of Canada and our recovery from the stresses of these strenuous times make it incumbent upon our nation to conserve all our assets, and to utilize those that must be used to the best possible advantage. The greatest asset we possess, our only hope for the future, lies in the brain power of our young men, who have been trained in school and college, and who are just entering upon their life work as scientists or engineers.

We should know where the recruits from our profession and from the related scientific professions are going, and to what duties they are assigned. We should know that their knowledge, skill, training and brain power are being used to best advantage. We should make certain that skilled trained men of our various professions are not being placed in minor positions, while places of responsibility are being filled by incompetents from other professions. We should protect the rights of the younger men of our profession. We should do everything that is

necessary to insure that these young men are being used to the best advantage of Canada and the Empire. We should not trust our affairs to lawyers, insurance agents, professional politicians, and such persons, persons who are too much in evidence in these days of stress, and on whom must rest the odium for our inefficiency, and who are responsible for a large percentage of our losses, for the wastage of man power, for the dissipation of our resources, and for the failure to utilize these resources to the best advantage.

Another matter that needs attention is the constitution of the final court of appeals for exemptions from military service. This court appears to consist of gentlemen of legal training. How such men can be considered competent to pass judgment on matters relating to essential and unessential industry passes understanding. What training do these men possess which makes them capable of passing judgment with respect to the needs of business, and the necessity or otherwise of technical supervision and guidance? In what way have they qualified themselves to determine whether men of the engineering profession and men of allied skilled trades are essential to the conduct of the industries of the country, whether industries connected with the production of war materials, or industries connected with essentials for civil life? Why is the Engineering Profession, and Business Administration not represented on this most important tribunal, that Canada's essential industries, and equally essential reserves of brain power are not protected by a competent man? Men of legal training, no matter what their rank, are incapable of formulating a correct judgment in matters relating to the Engineering profession, and in matters relating to scientifically trained men generally. The responsibility for making decisions in such matters should not be thrust upon them, and they would display wisdom in refusing to accept such responsibility.

The need of the hour is the organization of a very strong and influential committee whose duties shall be to:—

1. Make inquiries as to the disposition that is being made of trained engineers and of men trained in related scientific professions, particularly chemists and geologists, who come under the terms of the Military Service Act.

2. Make such representations as are necessary to the proper authorities to secure the allocation of trained men to suitable occupations, whether professional or skilled trade.

3. Secure the proper recognition of engineering training in the making of appointments in the military service.

4. Inquire into the reason why the head of the tribunal who decides on essential and unessential occupations should be a legal man, without knowledge of industry, when such decisions relate to the affairs of business administration and to technical matters concerning the Engineering and Allied scientific professions.

5. Assist in any way practical all the members of the various engineering professions who may come under the terms of the Draft Act, that they may secure equable treatment, and may be placed in the most suitable place for efficient service.

6. Assist the military authorities in placing engineers who are drafted in the places where they can render the most efficient service to the country.

7. Watch and guard the rights and privileges of the engineering profession from encroachment by other professions in public affairs, and more especially in military affairs.

Gentlemen, for the honour of the profession to which you belong, and for the safety and future prosperity of the country in which you live and in which most of you were born, you are called upon to organize to promote the efficiency of Military service of your country and to protect the rights and privileges of your profession.

Steel Highway Bridge Specification

The amended and approved General Specification for Steel Highway Bridges which has been produced after a great amount of time and effort have been spent on it by the members of the Committee, is produced complete in this issue and should be kept for reference as it is now the standard Steel Highway Bridge Specification of the Institute. This committee is now engaged on the Steel Railway Bridge Specification and at a later date the members of the Institute will further receive the benefit of the expert knowledge on this subject of the men composing the Committee.

Second Professional Meeting

Arrangements are well under way for holding the second professional meeting of the Institute at Saskatoon on August 8th, 9th, and 10th, for which a complete programme of papers has been scheduled dealing more particularly with the engineering problems of the prairie provinces. Owing to the stringent war measures railway regulations it has been impossible to secure any passenger rebates from the East. However, from assurances already given, and as a result of the success of the Toronto meeting, it is expected that a fairly representative contingent will be present from Ontario and Quebec. President Vaughan, who is one of the busiest of men, will attend and in addition is planning to visit all the Western Branches as far as Victoria before returning.

Fuel-Power Board Created

The announcement of the creation of a Fuel-Power Board by the Federal Government, the personnel of which consists almost entirely of well known members of this Institute, will be received with considerable enthusiasm by the engineering profession, affording further evidence of recognition by the Government and is a substantial, well-laid step in the stairway by which the profession is slowly but surely climbing to its merited position. The names of the men forming the board are a guarantee, that whatever they may be called upon to do, either in supplying information on the subject, or in advising the Government regarding a national policy for the development of Canada's fuel-power resources, the work will be well done.

If the first professional meeting in Toronto has influenced even in a minor degree the creation of this Board and if it has had no other result, it has then justified itself in no small measure.

Ottawa Branch News

The Geodetic Survey of Canada, International Joint Commission, Dominion Power Board, Opening Trent Canal, Dominion Peat Board, New Plant British-America Nickel Corporation, International Geodetic Co-operation, Visit to Intake Works, Dominion Chemists Confer at Capital, Personal Activities.

J. B. Challies, M.E.I.C. Associate Editor.

The Geodetic Survey of Canada.

The Geodetic Survey of Canada is the outcome of a realization of the great economic value to this country of a geodetic survey to control the accuracy of its logical sucessors, a topographic and hydrographic survey, and to co-ordinate the results of older surveys.

Theoretically, the Geodetic Survey should precede all others, but from the earliest history of Canada, both Dominion and Provincial departments have been compelled in connection with administrative work, to carry on both topographic and hydrographic surveys. With little correlation of these various efforts there has of necessity been duplication of both work and expenditure, with much consequent confusion. The Geodetic Survey of Canada will not correlate the direction of these multivarious survey activities, but it will co-ordinate all the results.

The main object of a geodetic survey is to furnish the necessary control for all other surveys. This control includes the determination of the absolute positions on the earth's surface of a comparatively few widely separated points, the directions and lengths of the lines joining them and their elevation above sea level; which results are obtained by systems of primary triangulation and precise levelling. After the positions of these "strategic" points have been definitely determined and permanently marked they become available as checks on the accuracy of all topographic and cadastral surveys in their vicinity and it is anticipated that ultimately all surveys will be referred to these marks, or to maps plotted therefrom, for correction. Without such accurate locations the errors of ordinary surveys would accumulate until they would obliterate the necessary accuracy of the survey and map. Indeed, the primary triangulation of the Geodetic Survey of Canada, by its corrective functions, stands in the same relation to other surveys as the Council of the Institute stands to all the branches.

The primary triangulation and the precise levelling that have been done are excellent in quality and form the basis from which other primary triangulation and precise levelling may be extended.

The work of the Geodetic Survey of Canada has been found useful in the surveys of the Militia Department, the Department of Public Works, the Hydrographic Surveys of the Department of Naval Service, the Irrigation and Water Power surveys of the Department of the Interior, and for all map making departments of the Federal and Provincial governments.

During the past season primary triangulation has been carried on along the Coast of British Columbia; in Northern Alberta; between Lake Superior and Lake of the Woods in Ontario; along the St. Lawrence river in Quebec; in New Brunswick and in Nova Scotia, including the Bay of Fundy; and this work will be continued during the present season. Altogether about 130,000 square miles of the more thickly settled parts of Canada have been covered by this triangulation.

Almost 11,000 miles of precise levels have been run, extending from Halifax to Vancouver with branches and closed nets in every province of the Dominion. During the present season new lines will be run in Quebec, Ontario, Manitoba and Saskatchewan.

Many engineering problems, for example, the establishment or relocation of provincial and other boundaries, the location of railways, canals and waterways, irrigation and reclamation and water power projects, highways, &c., &c., will be more readily and accurately solved and the necessary surveys can be checked from point to point without the present mode of repetition through various methods of obtaining the same results. Resurveying of erroneous work, and the repeated covering of the same ground will be greatly eliminated.

It will be readily understood that the results of this work will be invaluable to the public service, for example, in the location of timber limits, or mineral claims, where the clarity of their titles depends upon the accuracy of their location and freedom from confliction with adjacent claims or interests, thus saving work and labour by the avoidance of litigation.

When this work is more widely understood in Canada, its uses will be unlimited, and there may be confidently expected, a great saving of money and labour to the country's Governments, and to its public and private interests.

The direction of this highly technical work of great general interest, and of special value to the engineering profession, has recently been placed in charge of Mr. Noel J. Ogilvie, M.E.I.C., as Superintendent of the Geodetic Survey Branch of the Department of the Interior. The head office of the Branch is in the Geodetic Building recently constructed specially for the purpose of the Survey, and located close to the Dominion Observatory, Ottawa.

International Geodetic Co-operation.

Engineers of the Geodetic Survey of Canada are now engaged in projecting an arc of primary triangulation along the British Columbia coast from the Straits of Fuca to Dixon Entrance. The United States Coast and Geodetic Survey having undertaken an extension of this work to the head of Lynn Canal, the Canadian surveys are now contemplating the continuance of the primary triangulation along the Yukon river to the point of crossing of the 141st meridian of longitude. This work, when completed, and taken in conjunction with the extension contemplated by the United States Coast and Geodetic Survey of their triangulation in the vicinity of Tacoma, Washington, to the Canadian triangulation in the Straits of Fuca, will constitute a geodetic arc of over twenty-five degrees of latitude and will connect Alaska, the Yukon Territory and British Columbia with the recently adopted North American Datum.

International Joint Commission.

The International Joint Commission held its annual meeting in Washington the first week of April, and subsequently has had a session in the city of New York in May. The principal matter before the Commission was its final report in the Pollution Investigation. This investigation, which is one of very great importance to the people of the two countries has been carried on for over five years. It embraces the whole question of the pollution of boundary waters between the United States and Canada, from the Lake of the Woods in the west to the St. John river in the east, including of course the Great Lakes system. Field parties under the direction of Dr. Allan J. McLaughlin of the U. S. Public Health Service, and Dr. J. W. S. McCullough, Mr. F. A. Dallyn and Dr. John Amyot of the Provincial Board of Health of Ontario, were engaged for several seasons in collecting bacteriological data on which the conclusions of the Commission were to be based. Subsequently a corps of sanitary engineers under the direction of Prof. Earle B. Phelps was charged with the consideration of remedies for the pollulion found to exist in these boundary waters. With the reports of both its bacteriological and engineering experts before it, the Commission found itself in a position to prepare its final report to the two Governments, and that report has now been completed, and will probably be ready for submission to the Governments of Canada and the United States in a short time. Broadly speaking it may be said that the chief areas of pollution have been found to be in the rivers connecting the Great Lakes, particularly the Detroit and Niagara Rivers. Considerable pollution has also been found in the St. Clair, St. Mary's, St. Lawrence, St. John, St. Croix and Rainy River, though to a less extent than in the case of the two rivers first named. As this investigation affects to a greater or less extent the health of some millions of people living along the international frontier, the conclusions and recommendations of the Commission will be looked for with a very great deal of interest.

The Commission also had before it certain questions relating to the measurement and apportionment of the waters of the St. Mary and Milk Rivers. These two rivers arise in the northwestern corner of Montana. The former goes across the international boundary and empties into the Belly River, a tributary of the Saskatchewan. The latter also crosses the boundary, flows through Alberta for about one hundred miles and then back into Montana. The Waterways Treaty provides that for purposes of irrigation these two rivers shall be considered as one stream, and their waters divided equally between the two countries. The work of measurement and apportionment was placed under the jurisdiction of the International Joint Commission. The United States Government has been engaged for some time in the construction of a canal connecting the two rivers. This with diversion and storage dams will facilitate the carriage of the water to where it is most needed for irrigation purposes.

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The many friends of Mr. George Mountain, Past President of the Institute, and Chief Engineer of the Dominion Railway Commission, will be glad to learn that he is slowly recovering from his protracted illness.

Dominion Power Board.

Since the last issue of the Journal the personnel of the recently created Dominion Power Board has been announced. The Honourable Arthur Meighen, one of the most progressive and aggressive Ministers of the Union Government is permanent Chairman. Mr. Arthur St. Laurent, M.E.I.C., Assistant Deputy Minister of the Public Works Department is Vice-Chairman.

The other members of the Board consist of Mr. W. J. Stewart, M.E.I.C., Consulting Engineer to the Dominion Government regarding International waterway matters; Lt. Col. C. N. Monsarrat, M.E.I.C., General Consulting Engineer to the Department of Railways and Canals; Mr. John Murphy, M.E.I.C., Electrical Engineer, Dominion Railway Commission; Mr. H. G. Acres, M.E.I.C., Chief Hydraulic Engineer of the Ontario Hydro-Electric Power Commission and Consulting Engineer to the Department of the Interior; Mr. O. Higman, M.E.I.C., Chief Electrical Engineer, Department of Inland Revenue; Mr. D. B. Dowling, F.R.S., Geologist, Dept. of Mines; Mr. B. F. Haanel, M.E.I.C., Chief Engineer of the Fuel Testing Division, Department of Mines; and Mr. J. B. Challies, M.E.I.C., Chief Engineer of the Dominion Water Power Branch.

Provision is made in the constitution of the Board for appointment by the Board of assessors who will represent, when necessary, provincial departments concerned in fuel-power administration and investigation.

This Board will act as a medium to correlate the activities of all Dominion and Provincial organizations concerned with fuel-power matters.

Opening Trent Canal

The Trent Canal, begun a generation ago, was officially opened for navigation from Trenton to Lake Simcoe on Monday, June 3rd, the King's Birthday, by the Honourable Dr. Reid, Minister of Railways and Canals.

In addition to Mr. A. J. Grant and his chief assistant engineer, Mr. A. L. Killaly, who have had direct charge of the work, the Minister was accompanied by a large party of departmental engineers, including Mr. W. A. Bowden, Chief Engineer of the Department; Mr. L. Sherwood, principal Assistant Engineer; Mr. A. T. Phillips, Superintendent of the Rideau Canal; and Col. C. N. Monsarrat, general Consulting Engineer to the Department.

The six foot waterway from the southerly outlet to Lake Ontario waters at Trenton to Lake Simcoe, via Peterboro, has cost approximately $6,000,000. The northern half of the waterway, giving outlet to Georgian Bay, via the Severn River, will not be completed for some years, and will cost another $2,000,000. On the Severn river section, work has been suspended until after the war.

Meanwhile, the southern portion of the new transportation link will be principally of local benefit in enabling Peterboro and other points along the route, to bring in coal and other commodities at lower rates than railways can give. The canal will accommodate barges of 1,000 tons.

The power development along the canal is perhaps the country's best return for the millions spent on the undertaking.

Dominion Peat Board

Since the Fuel-Power meeting of the Institute at Toronto, the Government has taken definite steps to have the peat resources of the country adequately developed and used. On the initiative of the Minister of Mines, Honourable Mr. Burrell and Honourable Howard Ferguson, Minister of Mines for Ontario, the Governments of Canada and Ontario have appropriated approximately $70,000 for the purpose of constructing two types of peat machines to demonstrate the possibility of developing peat-fuel in the Acute Fuel Area of Canada on a commercial basis.

The Board consisting of four members, two representing the Government of Canada, two the Province of Ontario, has been constituted by Order in Cuoncil, charged with the responsibility of directing the design and construction of the machinery, the selection and preparation of a suitable peat bog and the conducting of manufacturing operations. The members of the Board consist of Mr. Arthur A. Cole, M.E., and Mr. Roland C. Harris for the Province of Ontario. Mr. R. A. Ross, M.E.I.C., of the Research Council, and Mr. B. F. Haanel, M.E.I.C., of the Department of Mines, for the Government of Canada. Mr. Cole is Chairman and Mr. Haanel Secretary. Mr. E. V. Moore, B.Sc., A.M.E.I.C., has been appointed as Engineer to the Board.

It is understood that a practicable demonstration by a suitable machine for manufacturing peat-fuel will be conducted on a peat bog situated in the vicinity of Toronto.

New Plant of British-America Nickel Corporation.

Deschenes, six miles from Ottawa, is at present the scene of intense activity. About seven hundred men are engaged upon the excavation for the foundations of a refining plant which is being built for the British-America Nickel Corporation. The plant will cover an area of about twenty acres. The main buildings, containing the tanks, will be constructed of hollow tile; in addition there will be a number of accessory buildings such as shops, warehouses, steam plant, etc. Messrs. Bate, McMahon & Co., are the contractors, and Col. R. S. Low is directly in charge of the work. The granulated matte, consisting of 80% nickel and copper, will be shipped from the Nickel Company's smelter at Sudbury to Deschenes; here the metals will be refined by the electrolytic process. The present plant will use about 6,000 h.p., which will be transmitted from Hull.

The late Arthur Bruce

The funeral took place in Ottawa on the 31st of May, of the late Arthur Bruce, a prominent and highly respected civil and construction engineer, who died Wednesday in the Royal Victoria Hospital, Montreal, after an illness of a couple of months. He was of Irish birth, the son of Col. H. S. B. Bruce, of Ballyscullion House, County Derry, and was in his 62nd year. He came to Canada when he was 19 years of age and was engaged with a party of Crown Land commissioners and later was indentified with Mr. G. A. Mountain in the construction of Coteau bridge for the old Canada Atlantic Railway. Since that he has done very important work for most, if not all the railways of Canada.

Ottawa Branch Visit to New Intake Works

On invitation of Mr. J. B. McRae, M.E.I.C., the Consulting Engineer on the new pumping station just installed by the City of Ottawa, and of Mr. A. F. Macallum M.E.I.C., City Commissioner, and through the courtesy of the Mayor and Board of Control, the members of the Ottawa Branch and their friends, to the number of about 125, were taken over the plant on the afternoon of Saturday May 18th. A good many motored all the way out, and the balance went by street car, automobiles meeting the latter at the point nearest the plant, an attention that, combined with other thoughtfulnesses of Mr. McRae, helped to make the outing most enjoyable to every one present.

The plant is located on Lemieux Island, near the southern or Ontario shore of the Ottawa river, about two miles from the centre of the city, and consist of a collecting basin supplying two turbine pumps, each rated at twenty million gallons against a total lift of 280 feet, discharging into two steel conduits which in turn feed the city mains at a point approximately half a mile away, a 1,600 h.p. induction motor direct connected to each pump, together with the necessary transformers, 11,000 to 2,200 volts, switching equipment, heating system, and all the usual accessories of a well equipped plant. Last but not least should be mentioned the buildings, substantial and attractive without being too ornate, which house the various parts of the equipment, and also the 760 foot four arch concrete bridge which spans the channel between the island and the mainland, serving the double purpose of a highway and a carrier for the conduits, which latter are overland throughout their entire length. There is also a chlorinating plant, forming part of the old low pressure station, and which is undoubtedly giving Ottawa a bacteriologically safe water, but this will shortly be abandoned in favor of a chlorine gas plant that is expected to give even better results and at a reduced operating cost at that. Provision has been made for it in the main pumping room, one nice feature being a system of automatic control whereby, once the proportion has been set, the chlorine used is varied, according to the output required from the plant, through a connection actuated by the venturi meter.

The visitors were conducted over the plant by Mr. McRae and Mayor Fisher, every detail and piece of equipment being carefully explained to all present. It was much regretted that, owing to the noise of the motors in the main pumping room, where the gathering broke up, the thanks of all those present could not be then and there publicly expressed to Mr. McRae, but they were afterwards extended to him by the officers of the Branch.

This gathering closes the spring session in Ottawa, as there will be no more meetings, outside of those of the Managing Committee, until September or October, when it is expected that the usual activities will be resumed.

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Major A. W. Gray, Chief Locating Engineer of the Dominion Parks Branch, Dept. of the Interior, who has been overseas for three years, has returned to Ottawa on a three months' furlough.

Dominion Chemists Confer at Capital

Upon the first occasion in the history of Canadian Industrial expansion in relation to the chemical industries of the country and of that of the chemist, a convention of chemists in Canada was held in Ottawa on the 21st and 22nd May at which representatives of the technical and professional chemist were gathered from all points of the Dominion from Nova Scotia to British Columbia. Co-incident with this gathering the Annual Meeting of the Canadian Section of the Society of Chemical Industry was held.

During the proceedings Mr. Keith, the Secretary of The Engineering Institute of Canada extended the hand of fellowship to the chemists, its fellow co-workers, and was warmly greeted by the meeting.

Matters of better organization of the chemist were taken up and thoroughly discussed, resulting in a committee being appointed to report at a future meeting.

General papers were read along lines of research carried out during the year and showing the present status of development of the chemical industries of the country.

Resolutions were passed emphasizing the necessity of legislation permitting the use of duty free alcohol for use in chemical industries for the future development in Canada of the essential chemicals so necessary to the needs of the country and to find profitable employment for the capital which will shortly be lying idle in the distilleries of the country by creating a new industry from this source; the desirability for putting into effect the report on technical education brought in by the Royal Commission appointed for that purpose, also for the desirability of printing at small cost and making thereby available for the public and those interested the patent specifications of the patent office.

The proceedings were brought to a successful close by a dinner on Wednesday evening, the 22nd May, at which several speakers pronounced upon the necessity of maintaining after the war the essential chemical industries already established in Canada through the cause of the war, if this country is to progress in the fullest manner and reap its reward for the sacrifices made by the chemist in doing his bit to help win the war.

The new chairman elect for the ensuing session is Dr. W. L. Goodwin of Queen's University, Kingston, one of the pioneers in the early formation of the Society in Canada.

Personal Activities

Mr. E. F. Drake, Superintendent of Irrigation, and Mr. R. J. Burley, M.E.I.C., of the Irrigation Branch, Department of the Interior, attended a meeting of the International Joint Commission in New York City, May 21st to 24th, for the purpose of discussing with the Commission the methods to be followed in measuring and apportioning the waters of the St. Mary and Milk rivers, and their tributaries, between Canada and the United States, under the provisions of the Waterways Treaty. Mr. A. P. Davis, Director and Chief Engineer of the U. S. Reclamation Service, and Messrs. J. C. Hoyt and B. E. Jones, of the U. S. Geological Survey, were also in attendance for the same purpose.

The Commission gave an order on 24th May, prescribing in some detail the method of measurement and apportionment, and directed Messrs. Drake and Davis to take the necessary action to carry the order into effect. Messrs. Burley and Jones will have charge of the necessary field work and will leave for the West early in June.

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Mr. Oswald S. Finnie, M.E.I.C., Inspecting Mining Engineer of the Department of the Interior, will spend the summer in connection with his official duties, in the province of Alberta.

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Mr. A. M. Beale, A.M.E.I.C., of the Department of the Interior, has joined a Construction Battalion, which will shortly proceed overseas.

* * *

A welcome visitor to Ottawa recently was Mr. Fred Anderson, A.M.E.I.C., Member of the British Columbia Legislature for the Kamloops district. Mr. Anderson's attention is hereby called to the fact that there is no member of the Engineering Institute in the Dominion House.

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Mr. Arthur L. Ford, M.E.I.C., who was until recently an associate of Professor Swain in preparing reports for the Drayton-Acworth Railway Valuation Commission, has been appointed to an important position in the Irrigation Branch, Department of the Interior.

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Mr. D. W. McLachlan, M.E.I.C., engineer in charge of construction at Port Nelson terminals, left Ottawa for Port Nelson on June 3rd, travelling via Winnipeg, Le Pas, Man., and Hudson Bay Railway. There is now continuous rail communication within 150 miles of Port Nelson.

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Mr. A. St. Laurent, Assistant Deputy Minister of the Department of Public Works, and Mr. S. Fortin, Structural Engineer for the same Department, were recently in Halifax for the purpose of looking over the reconstruction of the Dry Dock damaged by the explosion last December.

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Mr. W. F. M. Bryce, A.M.E.I.C., of the Ottawa City Commissioner of Works engineering staff, has recently been granted a Commission in the Canadian Engineers, and is now at St. Johns, Que., preparing to go overseas.

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Vacancies on the Ottawa Branch Managing Committee caused by the departure from Ottawa of Mr. W. J. Dick and Mr. W. F. M. Bryce, have been filled by the appointment of Col. C. N. Monsarrat, General Consulting Engineer to the Department of Railways and Canals, and Mr. A. F. Macallum, Ottawa City Commissioner.

* * *

Mr. G. H. Richardson, M.E.I.C., at one time Assistant City Engineer of Ottawa, was in the Capital recently en route to Toronto. Mr. Richardson has been a patient in the Royal Victoria Hospital, Montreal, for several months, but hopes after a short convalescence at his home in Toronto, to be able to renew his professional work in western Canada.

Report of Council Meeting

The report of the Legislation Committee presented and forwarded to Branch Committees will have an important bearing on legislation. A summary of the minutes of the meeting. Elections and Transfers.

The May Meeting of Council was held at Headquarters on Tuesday, May 21st.

After the minutes of the previous meeting had been read and confirmed Mr. Arthur Surveyer, Chairman of the Legislation Committee, presented the Committee's report regarding the Quebec Act, incorporating the opinion of Mr. Aimé Geoffrion, K.C., who had been consulted. After considering the report at some length it was resolved to send copies of the report together with the correspondence dealing therewith, to all members of the Council and to the Branch Sub-Committees of the Legislation Committee, deferring action until a later meeting of Council.

The Officers of the St. John Branch were approved as follows: Chairman, A. Gray, Secretary-Treasurer, A. R. Crookshank; Executive Committee, J. A. Grant, C. C. Kirby and G. G. Murdock.

The question of having the Secretary visit the Secretaries of the Founder Societies in New York and the Engineering Library was discussed. It was resolved that the Secretary make arrangements to go to New York as soon as convenient in order to secure information and become acquainted with the other Engineering Societies.

The Library Committee submitted a report the result of two meetings recommending that the books in the library be indexed and classified in accordance with the Engineering classification of the American Society of Civil Engineers. The Secretary reported having taken the question up with two of the assistants of McGill University Library and gave an estimate of time only of approximately $100. It was resolved that the Secretary engage library assistants to classify and index the books, the price to be not more than $100.

Society Emblem.—A progess report was made in connection with the adoption of an emblem by the Institute, it being intended that a complete report would be made at the next meeting of Council.

Officers Montreal Branch. The officers elected by the Montreal Branch were approved as follows:—

Chairman	Walter J. Francis
Vice-Chairman	Arthur Surveyer
Sec.-Treasurer	Frederick B. Brown
Executive Committee	
(for two years)	F. P. Sherwood
	W. Chase Thomson
	H. G. Hunter
(for one year)	L. G. Papineau
	O. O. Lefebvre
	K. B. Thornton.

Inspection and Sales Act.—The action of the Committee appointed to advise the Department of Trade and Commerce in connection with the amendments to the Inspection and Sales Act regarding the weight of cement was approved and the correspondence thereon noted. A complete report from Mr. Fairbairn, Chairman of the Committee, was requested for the next meeting.

Board of Examiners Quebec Act.—The acceptance of Messrs. J. M. R. Fairbairn and Frederick B. Brown of their appointment as members of the Board of Examiners under the Quebec Act was noted.

Branch at Sydney.—Councillor D. H. McDougall submitted his views in connection with the establishment of a branch at Sydney and in view of his advice it was decided that no action be taken in that direction.

Chemical Meeting.—The Secretary was instructed to convey to the meeting of the Society of Chemical Industry being held in Ottawa the greetings of the Institute and to express to them the willingness of the Engineering profession to co-operate with them in matters of mutual interest.

Toronto Branch Resolutions.—Resolutions adopted by the Toronto Branch on the recommendation of the Committee of Prestige and Influence were presented with a letter from the Secretary of the Toronto Branch, calling particular attention to items four, five, six and eight. Approval was expressed of the splendid spirit shown by the Toronto Branch in this connection and the Secretary was instructed to write a letter to Toronto Branch containing the views of Council regarding the resolutions upon which Council was asked to act.

Hamilton Branch.—It was resolved that the Secretary continue negotiations leading to the establishment of a branch in Hamilton and that he arrange for a meeting there at which he would be present.

Mortgage.—The arrangement with the Secretary of McGill University for a renewal of the mortgage on the Headquarters property for two years, at 6½%, arranged under the advice of the President and Messrs Ross and Duggan of the Finance Committee, was approved.

Co-operation with Am. Soc. C.E.—A Committee was appointed, consisting of Messrs. Phelps Johnson, W.F. Tye and H. R. Safford, to co-operate with the Am. Soc. C.E. as suggested in previous correspondence.

Legal Expenses B. C.—The amount of the statement of legal expenses incurred in combatting legislation sought by the B. C. Technical & Engineering Institute was approved and the Secretary instructed to pay same.

A report was received from the Legislation Committee of the Quebec Branch which included a list of schools and universities recommended to be recognised in connection with applications for admission. Secretary was instructed to bring this list to the attention of the Board of Examiners.

A large number of letters were presented by the Secretary which had already been considered by the Executive Committee, the contents of all of which were noted by Council.

Classifications for admission and transfer were made, the names to appear on the ballot to be opened at the next meeting of Council.

Elections.—A ballot was canvassed and the following elections and transfers effected.

Members: Collins, Charles Durham, Imperial Munition Board, Brantford, Ont.; Crockard, Frank Hearne, President Nova Scotia Steel & Coal Co., New Glasgow, N.S.; Fairbairn, Richard Purdom, Deputy Minister, Public Works Dept., Toronto, Ont.; Jacobson, Eric Anton, General Manager of Boving Hydraulic & Engineering Co., Ltd., successors to Boving & Co.. Lindsay, Ont.; Smaill, William, General Supt., Winnipeg Aqueducts Co., Winnipeg, Man.; Stansfield, Edgar, in charge of the fuel testing chemical laboratories of the Department of Mines, Ottawa, Ont.

Associate Members: Adamson, Ernest Kinnear, Res. Engineer and Supt., Western Power Co. of Canada, Stave Falls, B.C.; Brown Donald Macdonald, Lieut. Royal Engineers, Salonika; Cummings, Alfred, surveying and General engineering, Fernie, B.C.; Hanson, Edward Christian Adar, City Electrical Engineer, Saskatoon, Sask.; King, John Albert Shirley, in charge of D.L.S. party on stadia surveys, Ottawa, Ont.; Marshall, John, Resident Engineer and Supt., Regina Disposal Works, Regina, Sask.; Pratt, George Robert, mech. and fuel engr. Western Lines, C.P.R., Winnipeg, Man.; Puntin, James Henry, architect, specializing in constructional engineering, 308 Parke Block, Regina, Sask.; Rannie, John Leslie, supervisor of Triangulation on Geodetic Survey of Canada, Ottawa, Ont.; Reilly, Francis Bell, of Reilly, Dawson & Reilly, Architects, Surveyors and Engineers, Regina, Sask.; Smith, William Raywood, London, Ont., Lieut. C.E.F. at Engineres Training Depot, St. Johns, Que.; Warren, William Robert, Ch. Engr. Dept. of telephones, Regina, Sask.

Juniors: Allen, Robert William, Asst. City Engineer, City of Regina, Sask.; Bothwell, Robert Scott Clements, on engineering staff of the Canada Steel Corporation Limited, Ojibway, Ont., Bridges, Fitz James, District Engineer's office, Public Works Dept., Windsor, Ont.; Cassidy, John Francis, draftsman and assistant to John Sweeney, Res. Eng., Toronto Harbour Improvements, Toronto, Ont.; Collins, Lawrence Edward, with Canadian Steel Corporation, Ojibway; Kendall, Ralph, ch. of survey party for Canadian Steel Corporation, Ojibway, Ont.; Wright, William Gordon, asst. to consulting Naval Engr., Dept. of Naval service, Ottawa, Ont.

Transfer from class of Associate Member to that of Member: Hogarth, George, in charge of provincial Highways, under authority of Dept. of Public Highways, Ontario, Toronto, Ont.

Transfer from the class of Junior to Associate Member: Somers, Newton L., coke plant engr., Algoma Steel Corporation, Sault Ste. Marie, Ont.

Transfer from the class of Student to Associate Member: McKenzie, James Edgar, Pres. and mgr. director, J. E. McKenzie, Ltd., general contractors and engrs., Calgary, Alberta.

Transfer from the class of Student to Junior: Bishop, John Murphy, demonstrator in the Department of Mechanical Engineering, McGill University, Montreal, Que.

Montreal Branch

Executive busy planning for future. Sections formed. By-Laws Committee drafting By-laws in co-operation with Committee of Council.

Frederick B. Brown, M.E.I.C. Associate Editor.

Since the election of officers and Executive Committee of the Montreal Branch on March 14th, several meetings of the Committee have been held and good progress has been made in the organization of the Branch.

A Committee on By-laws under the chairmanship of Mr. Arthur Surveyer and in co-operation with a committee of Council is now engaged in drafting a set of By-laws for the Branch, taking advantage of the past experience of all the other Branches. It is expected that this set of By-laws will be presented to the Executive of the Branch for consideration at its next meeting and promises to be a model of clearness and simplicity.

Four Sections of the Branch have been duly constituted, namely, Civil, Mechanical, Electrical and Manufacturing. The Vice-chairmen named at the head of each of the four Sections together with their assistants are as follows:—

Civil: J. deM. Duchastel, H. M. Lamb; *Mechanical:* J. A. Burnett, John T. Farmer; *Electrical:* J. A. Shaw, A. Frigon; *Manufacturing:* S. F. Rutherford, H. G. Hunter.

A Papers and Meetings Committeee has been formed under the chairmanship of Mr. R. M. Hannaford who has as his Committee men the above named eight gentlemen. It is proposed to send out to the Branch members reply post cards on which will be indicated the Section or Sections in which each member is particularly interested. The whole membership of the Branch will then be classified and by a system of Telephone Teams each member available by telephone, in addition to receiving the regular notice of meetings of the Branch, will be telephoned to by a member of the Papers and Meetings Committee. Thus, if a member indicates that he is particularly interested in mechanical and manufacturing subjects a member of the Papers and Meetings Committee will notify him by telephone whenever mechanical or manufacturing subjects are to be dealt with at meetings of those Sections. Of course, every member of the Branch will receive a notice for every meeting of the Branch, but it is hoped to stimulate attendance at the various sectional meetings by refreshing each member's memory just before the meeting of the Section or Sections in which he says he is particularly interested.

Several discussions have already taken place in the Executive as to the desirability or otherwise of having so-called commercial addresses given before the Branch. The concensus of opinion now seems to be that under certain restrictions these commercial addresses are desirable and are a means of giving information to the members which is otherwise unobtainable. The Manufacturing Section, for example, could very well have addresses presented before it dealing with the commercial manufacture of various materials. A few

weeks ago a very interesting paper on varnish manufacture was given before the Montreal Branch by one of the leading local varnish makers and considerable information concerning the essential features of gums, solvents and oils was given to the meeting.

Messrs. W. F. Tye, Consulting Engineer, and Olivier Lefebvre, Chief Engineer, Quebec Streams Commission, have been appointed members of the Nominating Committee of the Institute representing the Montreal Branch.

Sir Henry Japp, M.E.I.C.

Members of the Institute will join in congratulating Sir Henry Japp, M.E.I.C., of 35 Churchill Avenue, Westmount, Que., whose work with the British War Mission has been rewarded as announced in the King's Birthday Honor List by his receiving the title, "Knight of the British Empire".

Sir Henry Japp was born at Montrose, Scotland, June 6th 1869, and received his education at Montrose Academy and University College, Dundee. From 1887 until 1895 he was engaged in mechanical engineering; 1887 until 1893 with the Caledon Engine Works, Dundee; the year following with the Thames Iron Works, London, and two years with Humphries & Tennant, London. His subsequent career until he joined the British War Mission was devoted to civil engineering and contracting. When war broke out he was President of S. Pearson Son & Partners Canada, Limited, Montreal. In July 1915 he joined the British War Mission first being associated with Lord Rhondda and later as second in command under Sir E. Pearson at Gretna Powder Factory, England; From 1915 to date, he has been in charge of the production department as Deputy Director General of the British Ministry of Munitions of War in the U.S.A., and in addition has been a member since September 1917 of the Advisory Board of Purchasing Department of the British War Mission.

Calgary Branch

Two meetings held in May. Addresses on Coal and on The Quebce Bridge. Mr. and Mrs. Porter entertained. Engineering Section of Board of Trade. Personals.

C. M. Arnold, M.E.I.C. Associate Editor.

Two meetings of the Branch were held during the month of May.

On May 10th, the Branch was given a very interesting address on "Coal" by Mr. Lewis Stockett, M.E.I.C., at the Board of Trade Rooms, which was attended by twenty members of the Branch. An interesting discussion followed after which a short business meeting was held.

On May 29th, the Branch and the Calgary public were addressed by Mr. Geo. F. Porter, M.E.I.C., on the "Quebec Bridge", illustrated by lantern slides. The meeting was held in the Calgary Public Library Auditorium and the public was invited. Unfortunately the hall has a seating capacity of but two hundred and fifty, and this was filled and probably half that number turned away. Great interest was manifested in this lecture, which was greatly appreciated.

At noon the members of the Calgary Branch entertained Mr. Porter at an informal luncheon at the Board of Trade, which was attended by thirty members of the Branch. Mrs. Porter, who with their daughter, accompanied Mr. Porter on his trip, was entertained at luncheon by Mrs. Wm. Pearce, to meet the wives of the members, and later at tea by Mrs. F. H. Peters. In addition to the value of the splendid lecture, all our members took the greatest pleasure in meeting Mr. and Mrs. Porter personally.

At the suggestion of the Calgary Branch of the Institute, an Engineering Section of the Board of Trade has been formed to take up and report on all Engineering questions of importance to the City, which may come before the board. The Chairman of the Engineering Section is Mr. F. H. Peters, M.E.I.C., who thus becomes one of the Council of the Board. Other Engineers, who are members of the Council are Mr. G. W. Craig, M.E.I.C., City Engineer, and Mr. Wm. Pearce, M.E.I.C., Chairman, Calgary Branch.

Personals

Capt. R. H. Goodday, who went overseas with the 56th Battalion, and who was wounded on active service, is now an instructor attached to the United States Army.

Lieut. V. Meek, who was overseas with a Tunnelling Company, Canadian Engineers, was wounded and has recently returned to Canada.

Vancouver Branch

Annual Meeting elects officers. Membership campaign. Larger Headquarters in Board of Trade Building.

A. G. Dalzell, A.M.E.I.C. Associate Editor.

The Annual Meeting of the Vancouver Branch was held on May 7th and the following officers were appointed:

E. G. Matheson.........	Chairman.
Newton J. Ker..........	Vice-Chairman.
A. G. Dalzell............	Secretary-Treasurer.
C. Brakenridge..........	Executive.
H. M. Burwell..........	"
T. H. White............	"
H. E. C. Carry..........	"
Newton J. Ker..........	Auditor.
E. A. Cleveland.........	"

A resolution was passed endorsing the proposal of the Calgary Branch regarding the obtaining of legislation to define the status of an engineer. A motion was passed recommending the Executive to form a strong membership committee and to endeavour to enlist the University students as Student members.

The request of the Victoria Branch to forward a petition asking Council to enquire into action of members associated with the proposed B. C. Engineering Institute was laid on table. It was proposed that effort should be made so that the members might inspect the concrete ship "Faith" due to arrive in Vancouver from San Francisco.

Mr. Brakenridge is acting as Secretary in Mr. Dalzell's absence.

The offices of the Branch are now on the 8th floor, Board of Trade Building, corner of Homer and Pender, the Board of Trade room on the third floor being inadequate, but the Society intends to keep in close touch with the Board of Trade.

Saskatchewan Branch

Mr. G. F. Porter's lecture and visit appreciated, Honor Roll unveiled, Arrangements for Professional Meeting, Personals, Names on Honor Roll.

J. N. deStein, M.E.I.C. Associate Editor.

It is with great pleasure and pride that we must look upon *our* "Journal" and it is only hoped that all the members will co-operate to make it the success it deserves.

As far as our Branch is concerned the main event during May was certainly the visit of Mr. G. F. Porter and family to our City. We feel that the standing of our profession as far as the opinion of the public is concerned would no doubt be considerably increased if Engineers of the type and prominence of Mr. Porter would occasionally visit our Prairies. We hope only that Mr. Porter had as much pleasure during the two days of his sojourn amongst us as we had. Our Committee had considerable difficulty in arranging for a breathing spell for our guests and we beg to apologize to Mr. Porter if the events crowded one another too much. We were fortunate, indeed, to be able to have His Honor, the Lieutenant Governor unveil the Honor Roll of our Branch at the dinner given in honor of Mr. Porter and family. We are proud to state that there are 18 names on our roll out of a total membership of about 75 and we hope sincerely to be able to welcome all those members at the conclusion of the world struggle.

The June meeting of our Branch will be devoted to a discussion of legislation and professional affairs prior to the coming *Western Professional Meeting* to be held under the auspices of our Branch in Saskatoon (August 8th, 9th and 10th), one of the sessions of which will be devoted to that subject. It has been arranged with the participating Branches (Manitoba, Calgary and Edmonton) and the Alberta Division to send two representatives each to meet a Committee of our Branch at Saskatoon on July 6th at a Preliminary Meeting in order to complete the arrangements. There are already a number of contributions promised for the five sessions (Concrete, Fuel, Good Roads, Water supply, Society and Professional Affairs) and all the papers to be read before the meeting will be in the hands of the Secretary by the end of June, so as to insure a thorough study and the preparation of discussions prior to our meeting.

We are contemplating to establish permanent quarters and are arranging with one or two other technical organizations to equip a room as a Library, etc., which will hold amongst others the generous contributions from our Parent Institute, Messrs. Jamieson, Ross and our Secretary Mr. Keith.

Personals

Mr. C. S. Cameron, A.M.E.I.C., has been appointed a Lieutenant in the Engineers, Mr. K. N. Crowther, A.M.E.I.C., is taking over his practice as Engineer and Surveyor.

Mr. O. W. Smith, M.E.I.C., past Chairman of our Branch who has spent the winter in Victoria has returned to our City.

Mr. E. B. Webster, A.M.E.I.C., has been transferred as District Inspector for the Highway Department to Yorkton.

Capt. V. Michie, A.M.E.I.C., a veteran of the Gallipoli campaign who until recently was Intelligence Officer for the Military District here, was obliged to resign on account of ill health.

Lt. L. W. Wynne-Roberts, J.E.I.C., at present in Mesopotamia with the 2nd Q.V.O., wrote sending greetings to the members and thanking for our Christmas wishes, his letter taking exactly 2½ months in reaching the Secretary.

The Honor Roll of the Saskatchewan Branch includes the following: W. T. Daniels, E. W. Longworthy, A. J. McPherson, D. A. Smith, G. P. M. Morse, H. G. McVean C. S. Cameron, K. M. Perry, L. W. Wynne-Roberts, W. G. Mawhinney, A. C. Garner, E. Milne, V. Michie, F. E. Emery, J. C. Meade, H. R. Murray, A. P. Linton and A. de C. Meade.

Toronto Branch Committee on Prestige and Influence.

Enthusiastic meeting of Toronto Branch discuss the resolutions prepared by the Committee on Prestige.

Geo. Hogarth, M.E.I.C., Associate Editor.

One of the most interesting, if not one of the most largely attended meetings, in the history of the Toronto Branch, was that held in the Engineers' Club, on April 25th, when the report of the Committee on Prestige and Influence was discussed. That there is a very general and somewhat intense feeling respecting the status and recompense of engineers, especially by the younger men, in comparison with members of other professions requiring no more training, initiative or intelligence, cannot be denied.

The Toronto members feel that this is a subject requiring the immediate attention and consideration of the Institute. The resolutions presented by the Committee on Prestige and Influence were adopted as follows:

Resolutions

1. That the Ottawa Branch be invited to co-operate with the Toronto Branch in the drafting of a bill for the restriction of the employment of engineers upon Public Works, such as federal, provincial and municipal works, to those who have conformed to the requirements which shall be defined therein; and such draft, after being approved by the respective Branches, to be submitted to the Council of the Institute for prompt consideration and action.

2. That legislation be obtained forbidding the expenditure of public funds upon the construction of bridges, roads, docks, harbors,

waterworks, sewerage and sewage works, electric light and power works and other undertakings, unless the plans for the same shall have been prepared by and the supervision is under the control of engineers who have conformed to the requirements defined in the proposed draft bill mentioned in Resolution No. 1.

3. That it is desirable that the Branch shall make provision for the payment of the Branch secretary, and that it shall be deemed part of his duty to keep in close touch with the members and to render every assistance for their professional advancement.

4. That the Council of the Institute be asked, in order to secure material for further discussion, to issue an enquiry to the members generally to ascertain the compensation received by engineers of various ages and in different classes, and employed in various technical services, and that steps be taken, if possible, to ascertain also the compensation paid to men of corresponding ages, classes and services in other professions.

5. That the Council be asked to organize a scheme for the defence of members who have been attacked in the performance of their professional duties on what may appear unjustifiable grounds.

6. That the technical work of the Institute can be most successfully carried on by means of technical sections to which shall be entrusted the organization of ordinary meetings, special sectional conventions, etc.

7. That the Executive Committee be requested to consider the suggestion of holding weekly or fornightly lunch meetings, at which addresses will be delivered and facilities given for the members to become better known to each other. Such practices as obtain at meetings of the Rotary or the Electrical Clubs might be followed.

8. Whereas in the vocation of engineers, technical knowledge is necessarily of primary importance, that the Council be asked to adopt every means in their power to make Transactions of the Institute a complete record of Canadian Engineering achievements and of Canadian engineering studies.

9. That it is desirable to appoint sectional technical committees who shall undertake special studies and investigations to be assigned to them. The appointments to such committees to be made only after formal acceptance of office by the nominees, and the work of the technical committees to be carefully supervised by the Executive Committee. In the case of appointees failing to carry out the work, the Executive shall, after due notice, request their retirement and elect others in their places.

10. As the Committee on Prestige and Influence has now completed the work referred to it, that it be continued.

The general discussion arising from the presentation of these resolutions showed how great was the interest they had aroused. The Chairman pointed out that it was with considerable satisfaction he noted the large number taking part in the discussion, as the majority present had given an expression of opinion on the various subjects. It shows further a realization that there is much to be done, combined with a willingness to co-operate towards its accomplishment. The interest that has thus been roused will have a far reaching effect on the activities of the Toronto Branch.

The individual members of the Toronto Branch are looking forward to the organization of a Provincial division for Ontario and expect it will fill a place in service to the profession which the Branches do not and cannot properly occupy.

The honor roll of the Toronto Branch, now nearing completion, contains one hundred and ten names, of whom two have been killed in action.

The Leonard Medal

Lieut.-Col. R. W. Leonard, M.E.I.C., intends sailing for England early in June. Before leaving he purchased a Victory Bond of $500.00 which he had registered in the name of the Engineering Institute of Canada to provide a fund for the Leonard Medal. This Medal has been kindly presented by Lieut.-Col. Leonard for the best paper of the year on a mining subject. He has placed the question of regulations in the hands of the Council of The Engineering Institute of Canada, but the Medal will be available to be awarded to the members of the Mining Institute also.

Now City Engineer

A. W. Haddow, B.Sc., A.M.E.I.C., who has been acting City Engineer for Edmonton, Alberta since the enlistment in 1915 of the late City Engineer Latornell, has now received the appointment of City Engineer. Mr. Haddow is Secretary-Treasurer of the Edmonton Branch and takes a keen interest in Institute affairs. Members of the profession will give hearty approval to this appointment of the City Commissioners of Edmonton.

Water Rate Arbitration Board

The determination of the rates to be charged by the Montreal Water & Power Company to the City of Outremont for water service during the continuance of a long term contract is now under consideration by a board of arbitration, of which Mr. Eugene Lafleur, K.C., is the Chairman, and Mr. Walter J. Francis and Mr. Arthur Surveyer, Members of the Council of the Engineering Institute of Canada, are the other two members. Mr. Frank H. Pitcher, Chief Engineer and General Manager of the Montreal Water & Power Company, is assisting Mr. W. J. White, K.C., and Mr. Aime Geoffrion, K.C., in the interests of the Water Company, and the Honourable Senator Beaubien, K.C., with Mr. J. Duchastel, City Engineer of Outremont, are looking after the interests of the municipality.

Engineers Proceed with Important Arbitration

The settlement of the differences existing between the City of Montreal and the Cook Construction Company over the contract for the second enlargement of the Montreal Water Works Aqueduct is proceeding daily before a Board of Arbitration, composed of Mr. W. F. Tye, Consulting Engineer, Past President of the Engineering Institute of Canada, Mr. J. M. R. Fairbairn, Assistant Chief Engineer of the Canadian Pacific Railway, Vice-President of the Engineering Institute of Canada, and Mr. Aime Geoffrion, K.C., Batonnier of the Montreal Bar. The City of Montreal is represented by Mr. P. E. Lamarche, K.C., with Mr. C. Laurendeau, K.C., as Counsel and Mr. Gordon Grant, M.E.I.C., of Ottawa as Engineering Advisor, while the Honourable J. L. Perron, K.C., Mr. F. E. Meredith, K.C., and Mr. A. R. Holden, K.C., represent the Cook Construction Company with Mr. Walter J. Francis, M.E.I.C., as Engineering Advisor.

Claims and counter-claims amounting to nearly three million dollars are involved. During the prosecution of the contract an accident happened to the water supply conduit of the city entailing great loss and inconvenience to the city. These damages, together with claims arising out of the uncompleted contract, form the subject of the arbitration proceedings.

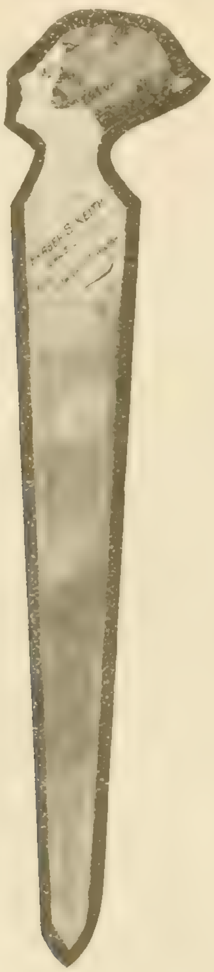
A great many witnesses have been called amongst whom are a number of the leading contractors and consulting engineers.

Souvenir from Passchendael

Unusual interest is attached to the souvenir recently received by the Secretary from Major William T. Wilson of Montreal, inasmuch as it comes from a district that has figured prominently in the recent fighting, and with which the name of Canada will ever be associated. It is intended to have this souvenir placed in a frame together with Major Wilson's letter, for safe keeping. The illustration hardly does justice to the splendid workmanship. Major Wilson's letter follows.

"Please express to the Council and members of the Society, my thanks for the Xmas present of tobacco but more so for the good wishes and kindly thoughts expressed with the gift.

We are all of us here glad that we are able to do a little for our Empire and for others and it does us good to know that we are still remembered by those at home.



Brass paper knife from Passchendael Ridge, 13 inches long.

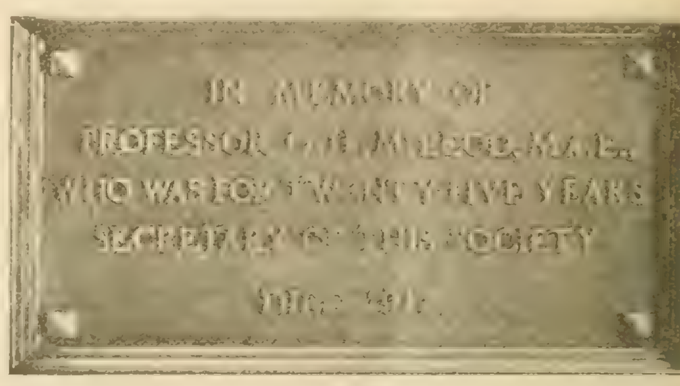
Please accept the enclosed paper cutter. It was made by hand on Passchendael ridge, it is cut from a captured German shell case and sketched with ordinary chinese ink, R.E., issue.

With best remembrances,

(Signed) WILLIAM T. WILSON.
Major R.E.

Memorial Professor McLeod

In accordance with a resolution passed at the Annual Meeting, a bronze tablet has been prepared under the direction of Council and is now placed in position on the wall in the main hall at headquarters, where it will remain as a silent tribute to one to whom the engineering profession in Canada owes so much. This is a solid bronze casting designed and executed by Henry Birks and Sons Ltd., Montreal.



Bronze memorial placed in the main hall at headquarters as a tribute to the memory of the late Professor McLeod and the position he occupied in the engineering life of Canada.

* * *

Lt.-Col. Monsarrat Honored

A farewell mess supper was given to Lt.-Col. Monsarrat at St. James Club, on Tuesday evening, May 28th, on his retiring from the command of the 5th Royal Highlanders of Canada. Lt.-Col. Monsarrat resigned from the position he has so long occupied on account of his removal to Ottawa, where he was recently appointed consulting engineer to the Department of Railways and Canals. In relinguishing active command of the Highlanders, Lt.-Col. Monsarrat retires with equal rank.

During the evening several brief speeches were made. Lt.-Col. Birchall, 5th R.H.C., referred to the reason for the function which was to extend the very best wishes of the Unit to the guest of the evening and prove to him the honor and esteem in which he is held.

There were present at the supper: the Honourable the Minister of Militia Major-General S. C. Mewburn, the Adjutant-General Major-General Ashton, the military secretary to the Minister, Col. H. C. Osborne, Major W. R. Creighton, Hon. C. C. Ballantyne, Minister of Marine; Sir Chas. Davidson, Major-Gen. E. W. Wilson, Col. Sullivan, Senior Ordnance Officer; Col. Stewart, A.D.S. and T.; Lieut.-Col. Leduc, A.A.G.; Col. Hill, G.S.O.; Col. Fages, Lt.-Col. L. R. Laflèche, Lt.-Col. Daly-Gingras, and Lt.-Col. Peers Davidson.

Personals

Francis J. Cronk, A.M.E.I.C., has been appointed Assistant Professor of Railway Engineering in the Faculty of Applied Science in McGill University.

* * *

Major T. R. Loudon, B.A.Sc., A.M.E.I.C., 1st Canadian Railway Batt. arrived in Canada recently and is now at his home in Toronto. He was invalided in January and has the distinction of having been mentioned in despatches.

* * *

M. V. Sauer, M.E.I.C., who has for several years been connected with the Greater Winnipeg Water District, has been appointed, Chief Hydraulic Engineer of Design for the Hydro-Electric Power Commission of Ontario, with headquarters at Toronto.

* * *

A. B. Manson, A.M.E.I.C., City Engineer of Stratford has secured a commission as Lieutenant for Overseas service with the Canadian Engineers. Lieut. Manson before leaving was given evidence of the esteem in which he is held by presentations from the Alderman, City Hall employees and the boys of the 28th Regiment.

* * *

Major Charles Flint, B.A.Sc., A.M.E.I.C., 4th Batt. Canadian Railway Troops, who has been promoted on two different occasions, has just been awarded the Croix de Guerre for gallant and distinguished service. Major Flint is one of the many C. P. R. men serving at the Front.

* * *

A. G. Dalzell, A.M.E.I.C., Secretary-Treasurer of the Vancouver Branch, is enjoying his first holiday in ten years and incidently helping in food production on a ranch of six sections near Vermilion, Alberta. Mr. Dalzell resigned his position as Assistant City Engineer of Vancouver about two months ago.

* * *

Congratulations are due Lieut. E. V. Deverall, M.C., R.E., now serving in Flanders with the 89th Field Coy., Royal Engineers, on being awarded the Military Cross for gallant service, on March 10th, 1918. Lieut. Deverall's mother, Mrs. T. Deverall, resides at 343 Shaw Street, Toronto.

* * *

John C. K. Stuart, A.M.E.I.C., has advised headquarters that he has secured a commission with the Royal Engineers. Mr. Stuart has been for a number of years engineer of construction with the Mount Royal Tunnel and Terminal Co. and before enlisting was engaged on special work with Ford, Bacon & Davies, Corpn. of New York.

* * *

Dr. Frank D. Adams, Hon. M.E.I.C., who is a member of the Advisory Board of the Khaki University, left on May 29th for England in connection with this work. The establishment of a khaki university in England for the men during the present time and during the period of demobilization has been decided upon and will have a definite bearing on the training of men for the engineering profession.

M. W. Plumb, A.M.E.I.C., who has for some time past been managing engineer for the Pneumatic Concrete Placing Company of Canada Limited, 112 St. James Street, Montreal, has been sworn in to the United States Government Service. Mr. Plumb has joined the Traffic Department of the 2nd Division of the Emergency Fleet Corporation of the United States Shipping Board, and intends devoting his entire time to this work until after the period of the war.

Heads Public Works Department

The reorganization of the Municipal Department in Montreal, by the new Civic Commission, has resulted in the grouping of twenty three departments under five heads, one of which the Public Works Department, will be in charge of City Engineer Paul Mercier, M.E.I.C. The Public Works Department will comprise the care of streets, the water supply, sewers, municipal buildings, including city markets, incineration, inspection of buildings, automobiles and the electric Commission. Since his appointment to this position on May 13th, Mr. Mercier has made recommendations to the Commission which include the amalgamation of the incineration and street cleaning departments which will affect a reduction of $400,000 per annum in the expenditure of the Public Works Department.

Lt. Francis' Remarkable Experience

Lieutenant Edward W. Francis, R.A., S.E.I.C., son of the Chairman of the Montreal Branch, is serving under General Allenby in the Egyptian Expeditionary Force. While en route to Egypt late in December, he had the misfortune to be on one of the transports sunk by the enemy in the Mediterranean. He writes most cheerfully to the Secretary and is apparently not in any sense downhearted. "On the boat I had some letters ready. These letters had to be abandoned, however, together with my kit, for it became a question of swimming for it. High explosive is no fit thing for any boat to hit, and when the boat contains no bulkheads, your position, to say the least, is undesirable. In slightly over two minutes the masts only could be seen and there was a swim of a few miles on hand. In this I was at scratch because I waited till last near my end of the ship. The swim, however, was broken up by some trawlers, and I am not sure who won. In future swims my name will not entered, at least not to start at scratch. The water was not cold at first, and since the finishing tape—land—was well in sight, the outlook was better than it might have been. The doctor said that a couple of weeks at the hospital would not do me any harm—and you do as you are told in the Army. Just out the other day and back to work again."

Lieutenant Francis lost everything he had excepting the uniform he swam in, but fortunately he escaped with his life. It is understood that the transport to which he refers is one of those announced by the Admiralty in February last, when a great many troops, officers and nurses lost their lives.

Organization Meeting in Hamilton

Representative Gathering of Engineers apply for permission to start Hamilton Branch.

Hamilton's place as an engineering and industrial center was strikingly emphasized last night at a meeting at the Royal Connaught hotel, when over forty engineers assembled for the purpose of establishing a branch of the Engineering Institute of Canada in this city. The institute comprises the professional body of Canadian engineers, and, although there are many members of the parent institute in the city, no local branch has heretofore existed. At the meeting, which was followed by a dinner, J. L. Weller, M.E.I.C., of St. Catharines, presided. Mr. Weller's name is well known and will go down in engineering history as the man who designed and superintended the construction of the Welland canal, the magnitude of which is not appreciated by Canadians. The city engineering department was well represented, as well as the Canadian Westinghouse, the Steel Company of Canada, the Hamilton Bridge company, the Otis-Fensom Elevator company, the National Car company, Standard Underground Cable company, the Wilputte Coke Oven company, and others. Members were also present from St. Catharines and Niagara Falls.

Fraser S. Keith, of Montreal, secretary of the Engineering Institute of Canada, was present, and explained the necessary procedure in forming a branch, giving information regarding the renewed activities of the engineering profession and other matters of general interest. He referred to the fact that Hamilton was a most important industrial center and promised a wonderful future for engineering activity. It was, moreover, one of the best situated cities on the continent, and could be counted on to take its place with the best in the industrial expansion that would follow the cessation of the war. Considerable enthusiasm was aroused in the discussion following, in which most of the men present participated.

City Engineer Gray pointed out the need for organization by engineers, it being essential that the men of the profession should be willing to take an active part as public spirited citizens in matters of general interest.

R. K. Palmer, of the Hamilton Bridge company, made a suggestion which was endorsed by all present, that the engineers should be willing to co-operate with the board of trade and other public bodies, in assisting to advance the material interests of the community.

A resolution was passed and an application signed, to be presented to the parent institute at Montreal, asking for permission to establish a branch in this city. Pending the granting of this request, E. R. Gray, was appointed chairman, and E. H. Darling, secretary.

At the dinner following, a few brief speeches were made, in which reference was made to the engineer's place in the development of industry and the material welfare of the municipality. When established the Hamilton Branch of the Engineering Institute of Canada, will wield considerable influence. Those present included: E. R. Gray, R. K. Palmer, E. S. Jefferies, Corbett F. Whitton, A. E. Heffelfinger, William W. Perrie, A. E. Kerr, F. Werner, A. J. Gray, Walter Jackson, H. A. Ricker, A. C. D. Blanchard, Norman R. Gibson, J. L. Weller, W. D. Black, E. H. Darling, John H. Jackson, James J. MacKay, James Stoddart, M. A. Kemp, J. B. Nicholson, Charles D. Campbell, A. S. B. Lucas, C. E. Brown, J. A. Knight, C. W. Baker, A. Failey, A. H. Murray, M. J. Henderson, A. S. Crooks, E. Strasburger, H. W. Blorham, H. B. Dwight, G. A. Price, P. Ford Smith, S. W. Brown, W. B. Hood, H. E. Janney.—*Hamilton Spectator.*

Edmonton Branch News

Lecture on Quebec Bridge, Election of Officers.

A. W. Haddow, A.M.E.I.C. Associate Editor.

Mr. Geo. Porter delivered his lecture on the Quebec Bridge, before the Branch, on May 27th. In addition to the membership, there were many visitors present. The meeting was held in the City Council chamber. The audience was very much impressed by the wonderful foresight which was exhibited by the engineers, in connection with the design, fabrication, and erection of the bridge. The excellent slides enabled everyone to follow the lecture very clearly.

The election of officers for the season 1918-19, was held on May 31st and resulted as follows:

Chairman: N. M. Thornton, Consulting Mining Engineer, Tegler Building, Edmonton, Mr. Thornton has taken an active interest in Society affairs, and in addition is closely indentified with the mining interests.

Vice-Chairman: J. L. Cote. Mr. Cote is a mining Engineer, also a mine operator in the Jasper Park coal areas. He is a member of the Provincial Legislature for Grouard constituency.

Secretary: R. J. Gibb, Assistant City Engineer, Edmonton.

L. B. Elliott, Dist. Eng. in Edmonton of the P. W. Department of the Dominion. Mr. Elliot is an ex-officio member, being the retiring Chairman, also a Member of Council.

R. Cunningham, Assistant Engineer, in the P. W. Dept. of the Dominion.

D. J. Carter, Representative in Edmonton, of the Dominion Bridge Co.

A. T. Fraser, District Engineer on maintenance, Canadian Northern Railway, Edmonton.

A. W. Haddow, City Engineer, Edmonton.

Mr. R. P. Graves, formerly Resident Engineer, in Edmonton with the G.T.P., has enlisted for overseas service with the Canadian Engineers, and has left for training at St. Johns.

Birthday Honors

In the list of Canadians honored, as shown in the birthday list, for services rendered to the Empire in connection with the war and who have distinguished themselves on more than one occasion, appear the names of Lt.-Col. George Eric McCuaig, D.S.O., A.M.E.I.C., who was made a Companion of St. Michael and St. George, and Lt.-Col. Ibbotson Leonard, A.M.E.I.C., who has been awarded the Distinguished Service Order. Both are McGill Graduates who heard the call in the early days of the war and they represent the type who are bringing honor to the engineering profession and to their native land. The entire membership of the Institute will receive this news with a feeling of pride in the honor that has been thus won by two of our corporate members.

EMPLOYMENT BUREAU

A Clearing House of Engineering Position in Canada.

This department is one of the features by which it is hoped to be of greater service to the engineer and particularly the younger men. Firms and individuals requiring engineering assistance will have their inquiries listed in this department. Those out of employment or desirous of a change are invited to make use of it, without charge and in confidence.

To make this department a success will require the heartiest co-operation of all members of the Institute, either by advising of any assistance required in your own department or organization or by pointing out to others who may have occasion from time to time to employ engineers that by using this department their requirements can be brought to the attention of the entire membership.

A peculiar situation exists at the present time. While the general engineering work is at a low ebb there is a steady demand for technical men, particularly for junior positions. Industrial life is more and more absorbing men of the engineering profession. For four years past very few engineers have been graduated from the Canadian Universities and of those who have the greater majority have gone overseas. With even a moderate revival of engineering work the future outlook would indicate that there is bound to be a scarcity and which, it would appear, will not be met in full by the return of the men from overseas.

The near future should see a decided increase in the salaries paid, to junior technical men particularly, and to all engineers working for salaries, in general. An indication of this is shown by the experience of a 1918 graduate from one of our Canadian Universities. He wrote in to the Secretary, stating that he would be shortly open for a position and that he was incapacitated for military service. An offer was made to him of a position at $100.00 a month but before he accepted this another offer was received at $125.00. Junior men must bear in mind, however, that consideration should be given to the experience to be gained as well as to the salary received. At the present moment the average engineer is justified in demanding 25% to 50% more than he is receiving. It is already high time that both professional pride and self interest should assert themselves in the minds of the engineering profession to the extent of having a higher appreciation of the value of the service rendered. If the men in higher positions, for many engineers are employed by other engineers, would realize this and see, that by working to secure greater monetary reward for the men under them, they would be elevating the status of the profession in the eyes of the general public, the reaction of which would tend to increase their own earning capacity, it would doubtless bring about beneficial results.

There is room for much thought in this connection.

Situations Vacant

Superintendents.

Two superintendents wanted for manufacturing plant, who will have general supervision of the plant, one for night and the other for day; must have had experience in handling men and mechanical and electrical experience. These positions offer splendid opportunities. Address applications to Box No. 1, Employment Bureau.

Chemist.

Chemist required capable of making analysis of coal, rock iron, etc., for manufacturing company. Address applications to Box No. 2.

Junior Draftsman.

Junior required for railway drafting office in mechanical department. Address applications to Box No. 3.

Mining Engineer.

Position is open for a junior engineer to commence as surveyor with a large mining corporation in northern Ontario. This position offers good prospects. Address applications to Box No. 4.

Mining Chemist.

Mining chemist capable of making assays of all minerals and of looking after the chemical requirements of a mining corporation. Address applications to Box No. 5.

Transitman.

A Power Co. near Montreal requires a transitman who will have an opportunity of working to a good position. Address applications to Box No. 7.

Works Engineers

One capable of taking off accurate quantities for mechanical equipment from engineers' drawings and who has a fair idea of the cost of various machine shop operations, pattern making, and the installation of steam lines, shafting and general mill equipment. This position offers $130.00 to $150.00 per month to start and promises a good opening later. Address Box No. 8.

Mechanical Draftsman.

Wanted for large industrial company, mechanical draftsman with technical education and a few years experience, one who is quick and energetic and capable of designing. State qualifications, experience and salary expected, to Box 9.

Inspectors.

Three inspectors for dock construction, pile driving and concrete work, and one timber inspector, required by Steel Corporation. In writing, give experience, salary expected, age and standing in regard to military service. Apply Box No. 10.

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MESSAGES FROM COUNCILLORS AND BRANCH OFFICERS TO THE MEMBERSHIP

Permit me to extend my hearty congratulations on the issue of the first number of the Journal of the Engineering Institute of Canada. The appearance and general make-up of the Journal is splendid and should be the means of very materially furthering that closer bond of comradeship amongst the members of the Institute, who are so widely scattered over this great Dominion, which is so essential to the welfare and prosperity of the profession as a whole.

GEO. D. MACKIE, Moose Jaw, Sask.
Councillor, E.I.C.
Chairman Saskatchewan Branch.

Geographical considerations render it so difficult for our members to meet together in conference and hear the spoken word. Some means were required to link together the aims and aspirations of the individuals, comprising the membership of what is today, the most important profession in the world, and a profession on which will devolve so much of the building up and reconstruction work all over the world after the great war has been waged to a successful conclusion, and it is my opinion that the new venture will be entirely successful in meeting this long felt want.

As you are aware, a summer meeting of the Manitoba, Alberta and Saskatchewan members of the Institute will be held in Saskatoon, Sask., in August next, and on behalf of the Saskatchewan branch, I extend a very hearty invitation to all members of the profession who can find it convenient to do so, to sojourn to Saskatoon in August, where they will be assured of a true Western welcome, and where many subjects of vital interest to the profession will be considered and discussed.

GEO. D. MACKIE,

* * *

I have read with very great interest the first number of our "Journal of the Engineering Institute of Canada" containing our President's message, which must, and doubtless does, appeal to every member of our profession.

A. E. DOUCET, Quebec, Que.
Councillor, E.I.C.
Chairman Quebec Branch

A well organized attempt to unite our Engineers in Canada, not only for the purpose of benefiting the members of the Institute, but also with a view of guaranteeing the safety of the works entrusted to their care, will, I am certain, receive the support of every wellwisher of the Institute.

That our first number should contain a full discussion on so important a subject as that of the Fuel Power Problem of Canada, a subject of such vital interest to every Institution, Manufacturing and Transportation Company and to the general public, clearly shows to what extent a Journal such as ours can be beneficial, not only to our members, but to the country at large.

I have heard nothing but praise as to the excellence of our first number, and I feel certain that future numbers will come up to, if not surpass, the record set in May 1918.

A. E. DOUCET.

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In the course of the usual routine of my work I meet many members of the Enginering Institute of Canada, and in travelling about Canada I see frequently many more of the men who are members of the Institute.

I think it may be fairly stated that all of these men are now busily engaged in doing everything possible to help win the war. This is the great task before us at the present time, and it seems to me that the only question a man should ask himself these days is—am I doing everything possible to help win the war? I think, that taken as a body the members of our Institute are truthfully answering this question in the affirmative.

JULIAN C. SMITH.

JULIAN C. SMITH, Montreal,
Councillor, E.I.C.

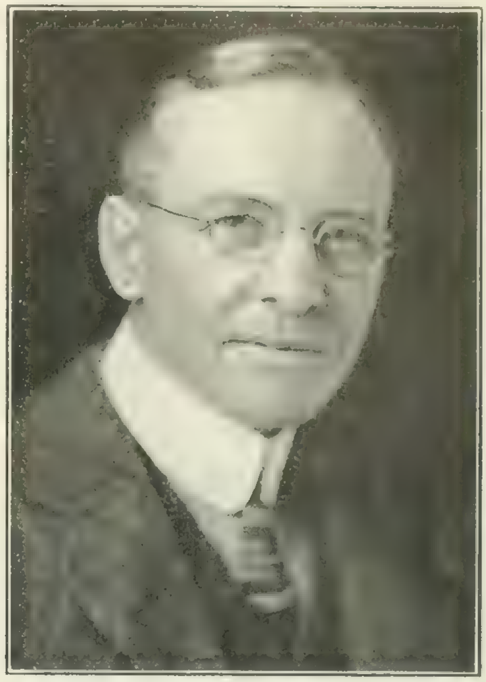
* * *

The engineers in Alberta are keenly alive to the unsatisfactory conditions under which they are living as professional men and are most earnestly seeking some way to change these conditions.

Let us recognize the fact once and for all that it pays to advertise and to organize. Let us recognize that we have had our heads so buried in our engineering work that we have failed to take a proper interest as citizens, and let us not blame the people for failing to recognize our good work when we have not had enough business acumen to point to it ourselves.

My message to other engineers would be to think about our engineering during the business day, but in the evening let us think and talk of our own material conditions and I have no doubt that a few years of effort will see our profession properly recognized and recompensed.

F. H. PETERS.



F. H. PETERS, Calgary, Alta.
Councillor, E.I.C.

* * *

This opportunity is grasped with pleasure because it enables me to thank in a special manner our "Civil Engineering" members who very generously supported

JOHN MURPHY, Ottawa
Councillor, E.I.C.

the recent successful movement, which it was my privilege to start, in connection with changing the Society's name.

Dropping the time-honored name of our organization and adopting a broader title were, in my opinion, essential steps towards making it a national organization truly representative of every branch of the engineering profession and of greater value to our country which we are all trying to serve.

JOHN MURPHY.

* * *

The movement for the licensing of engineers, which is active throughout the West, is one of the utmost importance to the future of the engineering profession. Hitherto, Quebec has stood alone for the enforcement of a law governing the practice of engineering. To-day, a plebiscite among the members of the Institute would show that the majority favour legislation.

ARTHUR SURVEYER, Montreal.
Councillor, E.I.C.

The best way to improve the status of the engineer is to obtain protective legislation in all the provinces. These laws should limit the practice of engineering to those properly qualified by education and training, and should prevent laymen from discrediting the profession by assuming a little to which they have no right and by attempting work for which they are not qualified. The various provincial bodies should be interconnected through the Engineering Institute of Canada, in the same way that the medical associations are linked together by the Medical Council of Canada and the architects' associations by the Royal Canadian Institute of Architects.

ARTHUR SURVEYER.

I want to congratulate the Engineering Institute of Canada firstly on its new attitude towards the Profession, secondly on its new name, and thirdly on the "Journal". I joined the Canadian Society of Civil Engineers in the first year of its existence and naturally feel a keen interest in its welfare. The change of attitude of the Institute towards its members and particularly towards those distant from headquarters is but an effect of the broadening view of the Profession towards itself. This change of view is due to the growing appreciation of the fact that a high grade of technical knowledge is not the only requisite to success in the Profession. Every engineer who has reached to a position of real responsibility knows his work has become one-quarter technical and three-quarters executive and administrative; that his ability to fill and hold this position is dependent on his ability to handle men, particularly the men above him. That questions of

F. A. BOWMAN, M.E.I.C., Halifax.
Chairman, Halifax Branch.

finance and methods of operation are just as important as the purely technical questions of construction.

The Halifax Branch is the baby one of the Institute, but we hope its babyhood will be short. In the course of another month or two we hope to have between fifty and sixty members of all grades, resident in the City.

Few who have not visited the City lately have any idea of the magnitude of the engineering works being carried out here. We who live here feel that the docks, terminal railway, oil refining works, ship-building plant, and the tremendous work of reconstruction of the area devastated by the Explosion form a group of engineering problems that justify us in asking that a General Professional meeting be held here at an early date.

F. A. BOWMAN.

All societies and organizations are dependent for ultimate progress and success, upon individual effort· The election of a Council or managerial board does not relieve the individual member of his responsibility (beyond the payment of dues) although this is apparently the general impression amongst a large section of our members.

R. W. MACINTYRE, M.E.I.C., Victoria,
Chairman Victoria Branch.

No individual member is so insignificant or unimportant as to be without the power to influence others in some channel of thought or action. To those members of our Institute whose interest has been hitherto academic and formal I would say do something, say something or write something that you can look back to by the end of this year and feel that the Institute has been benefited, however little, by the fact of your membership.

R. W. MACINTYRE.

M. H. MACLEOD, Winnipeg,
Councillor E.I.C.

My message is one of congratulation on the great endeavour for the advancement and solidification of the engineering profession.

M. H. MacLEOD.

Nova Scotia Water Power Administration

The industrial development of any country depends largely on its fuel-power resources, and the progress of industrial development in any country can be measured by the use to which available fuel-power resources are put. The fortunate position of Canada generally with regard to fuel-power resources is, as a result of the publications of the various Government departments concerned with the investigation and administration of fuel and power resources, fairly well understood. The one thing necessary to realize the best use of these resources is a national fuel-power policy which will co-ordinate the development and use of every element of our fuel-power resources according to its particular adaptability and availability.

No part of Canada is more fortunate in its resources of fuel and power than the province of Nova Scotia, which not only fills its own requirements but under ordinary conditions furnishes a large part of the coal supply for Quebec, New Brunswick and Prince Edward Island.

Some years ago the Nova Scotia Government realized the importance of their water-power resources and undertook a systematic investigation with a view to facilitating satisfactory legislation and administration for which purpose a Commission known as the Nova Scotia Water Power Commission was formed. This Commission entered into a co-operative agreement with the Dominion Water Power Branch, of the Department of the Interior, by which agreement, investigations have been under way for the past three years under the immediate direction of Mr. K. H. Smith, A.M.E.I.C. A special feature of these investigations to date has been the satisfactory results obtained from a comparatively small expenditure.

As a result of these investigations, the Nova Scotia Government at the session of the local Legislature just closed, introduced and passed legislation declaring the ownership of the province in all the waters of the province and providing for adequate water-power administration. In drafting this legislation, the Government was largely guided by the suggestions and advice of the Engineers connected with water-power investigations in the province.

Availability of Energy for Power and Heat*

By John Blizard, A.M.E.I.C.

The source of all our useful energy is the sun, which continues to supply us with food, fuel, rain, wind, and radiant heat, and has stored up for us in the past vast quantities of vegetable matter since converted into valuable fuels. The forms of energy available for conversion into power and heat are: water power, wind power, sun power, natural gas, oil, wood, peat, lignite, and coal. The cost of converting any one of them, as found in nature, into a specific quantity of the form of required energy, at the particular place required, is a measure of its availability. It will depend upon the cost of winning and transportation or harnessing, the cost of conversion, and the cost of transmission.

The cost of winning and transportation applies to the fuels, and is summed up by their price as delivered at the place of conversion. The cost of harnessing refers to expenses, such as those involved in developing a water power site. The cost of conversion applies to all, and its consideration involves an inquiry into the law of conversion. In its simplest form, this law states that any of the forms of energy may be converted into heat; but that the conversion of heat into work is never the sole result of a natural process. Thus, since the production of work by fuel involves the generation of heat, the best overall efficiencies of coal steam electric generating stations are of the order of only 18 per cent. But the overall efficiency of a hydro-electric station may reach 80 per cent. If, however, a fuel be used to generate thermal energy, as in a steam boiler, it is possible to recover 80 per cent of its energy. Thus the development of water powers for heating processes which the combustion of fuel will perform with equal efficiency, is a degradation of energy. For special electrothermal processes it is economical to use water power for heating; but they are exceptional, and practically all thermal processes should make use of fuels. For the same reason wind and water power should not develop heat energy. Unfortunately wind power is available only for small powers, while the cost of development and situation of water powers make it necessary to use fuels for the generation of most of the world's power supply.

The actual efficiency of conversion of the energy in fuels into mechanical or electrical energy varies considerably. It depends upon the class of fuel and the heat engine. Thus, the best thermal efficiency to be obtained with a steam turbine is about 26 per cent, and with the gas engine about 35 per cent. But the thermal efficiency is not the sole criterion of the cost of conversion, for the costs of the installation are an important factor. And the steam turbine, with its higher heat consumption, is able to compete with and outdistance its competitors for large stations, because of the much lower investment costs.

The energy of a fuel is invariably released eventually in the form of heat. But it is frequently converted into other modifications of fuel. A most important example of this type of conversion is the carbonization of coal, by which not only gaseous, liquid and solid fuels are produced, but numerous and valuable by-products.

The cost of transmission of energy will depend upon the class of energy transmitted, its price per unit, and the distance transmitted. Thus, it is economically possible to transmit electrical energy to great distances, gas of high calorific value to comparatively long distances, low calorific value gas to shorter distances, and steam or hot water only in the vicinity of the plant.

It is obviously of great importance to the community as a whole to see that all forms of energy serve in the best way the purpose for which they are most available. To choose energy and means of using it for a particular purpose is not simple. Thus, energy for road transportation may involve a comparison between oats and gasoline; and horses and heat engines. For a mill with a high load factor the issue may be between the Diesel-engine and water power; while for a poor load-factor the steam turbine plant alone may be worth considering.

It may appear at first sight that, since sellers and users of energy sell, generate, or buy to the best advantage to themselves, things will be adjusted so that energy is used in the most economical manner. This is true for the most part. But they are compelled to use only the available forms of energy, and to convert them into the required form in the apparatus which manufacturers supply. To better these conditions, three things are necessary: first, it is necessary to examine the whole community's requirements; secondly, to take stock of the sources of energy, and, thirdly, to see how they may meet the requirements to the best advantage.

An inquiry into these three subjects would be of great breadth, depth, and variety. Once completed, it would be of very great value. Constant change in a country's development and its methods of generating heat and power, would necessitate its frequent revision. But until such an inquiry is being prosecuted continuously with great vigour, both in the field of commercial use and development, and in laboratories independent of private interests, a country will be at a disadvantage.

It is proposed here to outline the sources whence we in Canada receive our supplies of energy, and the requirements they meet.

Coal is of first importance. In the course of a year we burn 30 million tons, of which 60 per cent comes from the United States. The remainder is mined in Canada.

Practically no coal supplies exist between the provinces of New Brunswick and Saskatchewan, and the combined output of these two provinces amounts to only 4 per cent of the country's production. One half of the remaining 96 per cent is mined in Nova Scotia, and the other half is mined in the provinces of Alberta and British Columbia. The coal reserves of Canada are enormous, and we may rely on a continuance of native supply for a very long period of years. Whether we may place equal reliance on our supply from the United States, or not, is uncertain. The present shortage seems to be

*Read by the author before the Ottawa Branch and approved by the Papers and Publications Committees for publication in the proceedings of the Institute.

due to abnormal difficulties of transportation, rather than those of production. It is certain, however, that the supply of anthracite from that country will decrease, and that the time is not far distant when they will come to us for their supply of coke or coking coals.

A part of the annual coal consumption is accounted for as follows:—

Manufacture of coke....	2	million tons
Railway locomotives....	9	" "
Collieries...	1	" "
Bunkering ships........	1	" "

The remaining 17 million tons are used for domestic and general manufacturing purposes. An approximate estimate of its subdivision is : 5 million tons for domestic heating, 6 million for industrial heating, and 6 million for industrial power.

Assuming that the colliery consumption is for power purposes only, and that 7 pounds of coal generates a horse power hour, the total mean continuous applied horse power in Canada derived from coal is 600,000, of which locomotives develop 300,000.

Water-power is used for the most part to supply mechanical and electrical energy. About 2 million horse power has, so far, been developed. The total available horse power is estimated at about 18 million, of which 8 million is estimated to be available within the present range of markets. An additional development of 6 million horse power, assuming an efficiency of conversion of 60 per cent, and a plant factor of 40 per cent, would supply about 1½ million horse power continuously. This is much more than sufficient to supply that generated yearly by our 16 million tons of coal.

Wood is a very important Canadian fuel. The estimated value of firewood used during 1916 was 62 million dollars, or more than the value of our coal imports. Although, to some extent, its use may be for power generation, principally in log-product factories, it is probable that most of it is used for domestic purposes. It is not likely that it will, to any extent, be able to take the place of other forms of energy, except spasmodically, as in times of an acute scarcity; nor is it likely that other forms of energy will take its place.

Oil and Natural Gas occupy an inconspicuous position compared with wood, coal and water-power.

The annual oil consumption is about 250 million gallons, and practically all of it is imported. It is in a more available form for the generation of power and heat than any other fuel. While not impossible to replace it with other forms of energy for small gasoline and kerosene engines, such a change could be effected only with great inconvenience. In addition to its use for these purposes, crude oil in large quantities is used, particularly in the West, for railways, ships, and industries. Altogether, at least one hundred million gallons are burned under steam boilers.

Mr. Van H. Manning, Director of the United States Bureau of Mines, in reviewing the oil situation of that country, estimates that its supply at the present rate of usage will last only 25 years. He further remarks that petroleum should be used neither for gas manufacture, nor for fuel under boilers, nor in any way to compete with coal. It would appear then that we must soon find another source of supply. This may come from the known shale deposits of Canada or the United States, or, possibly, from the vast unexplored areas in the west of Canada. The distillation of oil shales would not be a new venture, since, in Scotland, 3 million tons are produced annually, giving about 20 gallons of oil to the ton. Another source of oil is tar obtained from the distillation of coal and lignite. Benzol, another coal distillation product, is an excellent motor spirit, though, to counteract its tendency to freeze at only fairly low temperatures, it is necessary to mix it with alcohol or gasoline. Still another coal by-product, napthalene, may be used for explosion motors.

There is no doubt that alcohol is destined eventually to become prominent as a motor spirit. It is of particular importance, since it may be obtained from vegetation, and is thus independent of the stored sources of energy.

Natural gas is used in particular districts adjacent to the gas fields. Its high calorific value, nearly twice that of coal gas, renders its distribution over a large area economically possible. The annual consumption in Canada is about 20 million thousand cubic feet. It is used for industrial and domestic purposes. Since it is in a form more available for the generation of power than any solid fuel, it is advantageous to use it for this purpose whenever possible instead of coal.

Peat contributes practically nothing to our energy requirement. Yet it exists in large quantities throughout the Dominion, and in view of its success as a fuel in other countries, and the information obtained from its manufacture and use here, its availability for the generation of power and heat is known. It is impossible to believe that there is no field for its exploitation, and it must be expected soon to find a position as a source of heat and power.

This faint outline of our requirements and sources of energy does not afford information sufficient for proceeding with an inquiry which will lead to the connection of the user of power and heat with the most available form of energy. Here the possibilities of increasing the availability of our supplies of energy will be considered with reference to special methods. They will refer only to the establishment of central stations for the use of the solid fuels, and to the possibility of using hydro-electric energy for house heating.

Central stations. The central station may be designed to supply electrical energy, gas, steam, liquid fuel, solid fuel, and various by-products, many of which have no connection with the generation of energy. The economy of operation depends upon many factors, one of the most important of which is a large system in which there is more complete utilization of the full capacity of the plant. This is due to non-coincidence of the maximum loads of the various consumers, better thermal efficiency of conversion due to the use of larger units, more complete and intelligent supervision and design, and to the possibility of operating for longer periods at the more economical rated load. The limit of the central station's sphere is reached, when it is cheaper to haul the fuel to the consumer than to deliver energy through pipes or along a wire. It varies with local conditions and the type and

price of the fuel. It will be greater for low grade than high grade raw fuel, since costs of transportation vary with quantity and are independent of energy content.

The largest field for the central station will be in the generation and distribution of electrical energy. The rough estimate of the mean present power load now met by coal showed the very large requirement of locomotives. To replace the uneconomical steam locomotive with the electric locomotive seems at first sight a rational project. Where the substitution has taken place, the coal consumption in the central steam electric stations is one-half of the former consumption on the locomotive. There could be no objection to its substitution for oil in forest areas, and the present damage from locomotive soot and sparks would cease. An examination of the roads electrified shows that they are confined for the most part to suburban and mountain traffic. But the electrically equipped mileage is increasing, and the continuous increase in the price of coal brings the day of general electrification nearer.

The remaining power, which is used for general industrial purposes, is in itself of magnitude sufficient to warrant the consideration of central station supply. Whenever external electric supply takes the place of energy generated at the plant itself, economy results. In many districts this change has resulted in reducing the coal consumption to one quarter of its previous magnitude.

Central stations distributing gas have not so promising a field as those distributing electrical energy. The costs of transmission, and the relatively high efficiency of conversion of coal into heat energy in the plant itself, reduce the possible gain to the buyer. Nor is it likely that the substitution of this type of plant would save fuel. Nevertheless the cleanliness, and improved availability of gas as compared with coal would frequently lead to its preference by consumers.

Types of Central Stations. They may be of the following four types:

a. Those in which the fuel is completely gasified by partial combustion, and the energy distributed either as gas or electrical power.

b. Those in which the fuel is carbonized and energy distributed in the form of solid fuel, and gas or electricity.

c. Those in which the fuel is completely burned and electrical energy and steam distributed.

d. Those in which fuel is completely burned and electrical energy only distributed.

A consideration of these stations follows:

a. The by-product recovery producer plant is the most promising means of totally converting solid fuel into gas. Its economic importance lies largely in the high returns possible by the recovery of from 60 to 70 per cent of the nitrogen in the fuel in the form of sulphate of ammonia. It is of great value for the exploitation of low grade fuels, particularly peat, whose nitrogen content is high compared with its calorific value. The gas produced has a heat content of about one-fourth that of coal gas. It may be distributed to consumers, or partially converted into electrical energy by use of gas engines or boilers and steam turbines.

In South Staffordshire, a plant has been in operation for some years, and supplies gas over an area of 123 square miles. The price paid for the gas varies from 3 to 5½ cents per thousand cubic feet. The fuel used is slack coal of a fairly low calorific value. This is the only plant which distributes producer gas on a large scale, and it is noteworthy as a possible reason for its unique position that no dividends have been paid for some years.

In Italy two by-product plants, using peat, are in operation. The energy is distributed electrically.

b. The two outstanding objects of carbonizing coal are to obtain a maximum yield either of coke suitable for metallurgical purposes, or of gas suitable for domestic purposes.

The first method of carbonizing is carried out in coke ovens, wherein the long time of carbonization, large size of charge and compression, give a coke of the requisite great density and hardness. It is possible with modern coke ovens to obtain a yield of gas more than sufficient for heating the charge, about 20 per cent of the nitrogen in the coal as ammonia, in addition to light oils and tar. The surplus gas in usually of only slightly lower calorific value than town gas, and is eminently suited for distribution for general use, or may be used as a fuel at the plant for the generation of electrical energy.

The second method of carbonization differs from the first in that smaller charges are used in order to obtain the necessary quality and quantity of gas, none of which is used for heating the retorts. As with coke ovens, coke, ammonia, benzol, and tar are recovered as by-products from retorting coal. The yield of coke, however, is less and some of it is used for heating the retorts, while the ammonia yield is greater, due to the smaller contact with the smaller charge.

The coke obtained from retorting the gas is soft and loose in structure, and may be used in domestic furnaces; its disadvantages for this purpose are its bulk—which necessitates more frequent firing than with coal and larger storage space—and its tendency to clinker.

The choice of installing coke ovens or gas making retorts, both of which require much the same class of coal, obviously depends upon the possible market for the products. The development of a domestic fuel trade in the soft coke is possible, if a suitable market can be found for the gas. Metallurgical coke, on the other hand, is not so suitable for domestic purposes, since it is very hard, difficult to ignite, and requires a strong draft to burn it. Nevertheless, it may prove a valuable and economical substitute for anthracite coal, if sold at a reasonable price.

c. The third type of station represents the most economical means of generating power where coal is reasonably cheap, and all the exhaust steam may be used for heating. The prime mover may be either a steam engine or steam turbine of a comparatively cheap type, and no condenser is required, since the power may be looked upon as the by-product and the steam as the most valuable product. It is not possible frequently, however, to find useful employment within a small area for the exhaust steam, and heat losses prevent the transmission of thermal energy in the form of steam or hot water over a large area. On the other hand, it may prove feasible to generate power in plants where a heating load exists, and transmit electrical energy to customers in the neighborhood.

d. This is the most popular type of power plant, and in large sizes consists of boilers, turbo generators and condensers. It is too well known to need description, but it is interesting to note that steam turbines are made 70,000 kilowatt capacity, and operate with steam pressures and temperatures as high as 350 pounds per square inch and 690°F.

Each of these stations has a field of use. To say what field, without more information, would be mere speculation.

The possibility of using hydro-electric energy for house heating. There is a prevalent notion in the public mind that the country should settle once for all the difficulties and inconvenience of securing and burning coal for heating houses, by developing and using water-powers for this purpose.

At first sight it seems reasonable to reduce the consumption of our transitory possessions, the fuels, by using a continuous source of energy, which is at present going to waste. It is pleasant to contemplate the substitution of the cheerful electric radiator and switch for the complications of the present system. But the substitution by this method is based on a wrong principle.

Recurrence to the previous remarks on the laws of conversion of energy will show that the conversion of electrical energy into heat, as when a current flows along a conductor, is a degradation of energy. To use this highly available form of energy for heating by passing the current along an electrical resistance is to disregard its full potentiality. It is true that by this means all the electrical energy is converted into useful heat. But it is capable of much more than this. The method of application is precisely that in every day use in refrigerating machinery; wherein heat is taken from a substance, usually brine, at a low temperature, and is delivered, together with the energy supplied to the machine, to another substance, usually cooling water, at a higher temperature. Knowledge of the laws of thermodynamics shows that, where the temperature difference between the two substances is not very great, this scheme for removing heat from a cold body and delivering it to a hot body is thermally a very economical means of applying mechanical or electrical energy for heating. For the ideal cycle of operations as used in refrigeration the ratio of heat extracted at the lower temperature to the work expended on the substance, ammonia, carbon dioxide, or sulphurous acid, lies between 3 and 6. Lord Kelvin discussed this method of heating in 1852, and suggested its possible use in harnessing Niagara to the task of warming houses in Canada and the United States.

He considered the use of a heat-pump working on a cycle the reverse of the Joule heat engine. The substance to be heated was air, and the temperature of the atmosphere was taken as the lower limit. Here an example will be worked out in which air is heated to 100°F. by this cycle, cooled to 70°F. in warming the house, and receives heat from the lower temperature source by the freezing of water. This heat engine will take in the air at atmospheric pressure and 70°F., permit it to expand adiabatically (i.e. reversibly without allowing heat to enter or leave the substance), until it reaches a temperature, t, below 32°F. The air next receives heat at constant pressure, from freezing water, until it reaches 32°F., after which it is compressed adiabatically to 100°F. and delivered at atmospheric pressure to the house. The lowest temperature, t, is easily found, since the ratio of the absolute temperatures of air between the same two pressures must be constant for adiabatic compressions or expansions. Therefore,

$$\frac{460 + 70}{460 + t} = \frac{460 + 100}{460 + 32}, \text{ and } t = \frac{530}{560} \times 492 - 460 = 5.6°\text{F.}$$

The total heat given to the air is .24 (100 – 70) = 7.2 B. Th. U.; the heat received from the water is .24 (32 – 5.6) = 6.3 B. Th. U., where .24 is the specific heat of air at constant pressure. The work done on the air for the complete cycle is, therefore, (7.2 – 6.3) or 0.9 B. Th. U.; and the coefficient of performance is 8. That is to say, for every heat unit paid for to drive the machine eight are delivered for use.

There are many difficulties connected with a scheme of this nature, such as the freezing of the moisture in the expanding air, the capital cost of installation, and the removal of large quantities of ice formed by freezing the water. But the example shows that it is not outside the realms of possibility for a heat pump in a house to deliver the energy equivalent of, say, 2 horse power hours for every horse power hour available in water at the head of the falls.

It is interesting to compare the quantities of heat available for each cent expended on electrical energy and on anthracite coal. On the assumption that coal costs $10.00 per ton, has a calorific value of 12,500 B. Th. U. per pound, and is burned in a furnace of 55 per cent efficiency, 13,750 B. Th. U. are obtained for one cent. With electricity, on the assumption that the actual heat pump has a coefficient of performance of 4, and that electricity costs one cent per kw. hour, 13,700 B. Th. U. are obtained for one cent; from which it appears, on this basis, that there is little to choose between the schemes. The removal of ice, and general operation and noise of the electrical plant would be at least as objectionable as the present system. But it is unnecessary to further consider the possibility of using a hydro-electrical scheme for this purpose; since, if a community had to rely on hydro-electric energy entirely for house heating, it would be necessary to develop power sufficient to supply heat for the coldest day of the year. The hours of full use per year of the plant would be so low as to render the scheme financially unsound.

Conclusion.

The economical development and use of our sources of energy is a subject of very great importance. A full inquiry into our energy requirements, sources of energy, and the best way of meeting the requirements would be of inestimable value, and finally should lead to a cheaper and more abundant supply of heat and power.

It was an engineer who introduced the present age of energy. It came with Watt's invention of a steam engine, and with it began the depletion of our largest available store of energy, coal. It is for the engineer to prolong this age. He must not fail to draw energy from the right sources, through the best channels, and use it with a minimum loss. And there is ever before him an immeasurably greater question. It is the consideration of the availability of the natural continuous supply of energy for the generation of the world's requirement of heat and power.

City Light and Power Department, Winnipeg, Man.*

By J. G. Glassco and E. V. Caton, M.E.I.C.

The Power Plant of the City of Winnipeg's Hydro-Electric System is situated at Point du Bois, on the Winnipeg River, 78 miles northeast of Winnipeg. At this point the Winnipeg River, with its tributary, the English River, has a drainage area of 52,000 sq. miles, of which 22,000 square miles are tributary to the English River. The whole drainage area is covered with lakes and muskegs, making an ideal condition for conserving the rain fall.

The two principal lake areas in the watershed are Lake of the Woods and Lac Seul, the former being the source of the Winnipeg River proper, and the latter the source of the English River. In the Lake of the Woods drainage area there is a lake area of 3960 square miles, or over 14% of the total area.

The drainage area of the Winnipeg and English Rivers is shown in Plate 1. Owing to the nature of this area the flow conditions are exceptionally regular and no sudden rises of the river take place.

During the last twenty years the flow of the river has varied from a minimum of 11,000 sec. ft. to a maximum of over 70,000 sec. ft. With the regulation now possible at the Lake of the Woods and slight additional regulation on the English River, a minimum flow of 20,000 sec. ft. may be obtained.

For further information on the control of the waters of the Winnipeg River the writers would refer to the various publications of the Hydrometric Branch of the Department of the Interior, and to the Report of the International Waterways Commission on the Lake of the Woods Levels, in which the whole subject is exhaustively dealt with.

At the point where the plant is located the river had a natural drop of from 33′-28′, depending upon the stage of the river. This drop took place over two distinct ridges, which, together with rapids and disturbed water, made up the total head, the drop taking place in a distance of 1400 ft.

The narrowest part of the river was at the head of the falls, and it is at this point that the dam is situated, which has resulted in a head of from 47′–43′, depending upon the state of the river.

This dam consists of a rock fill, with concrete overflow section. The rock fill extends from the east shore a distance of 700 ft. At the west end of this dam the spillway commences and extends across the river to the forebay intake, just above which it curves in an arc of 90 degrees, and runs parallel to the course of the river. At the west end of the rock fill, and connecting it with the spillway, is a log shute and fish-way, of reinforced concrete.

The total length of the spillway is 1500 ft. and consists of four sections, 550′ on the original high water course of the river at the crest of the falls, 480′ on the point of land at the west shore of the river, 245′ on the curved part immediately above the intake, and 225′ in the canal wall. The crest of this spillway is 7.4 feet below the fixed elevation of the upper waters, and will allow a discharge of 100,000 sec. ft.

From the intake the canal extends a distance of 1600 ft. parallel to the flow of the river, the power house being situated at its south end. The canal wall extends along the east side of the canal, joining the intake with the power house. From the west end of the power house a wing wall connects the power house building with the height of land.

The raising of the head water and consequent flooding has resulted in a pond of still water of 6000 acres.

The intake is a reinforced concrete structure consisting of seventeen openings which can be controlled by stoplogs.

Immediately above the intake is a log controlled sluice.

The power house, which extends across the south end of the canal, is a reinforced concrete building and acts as a gravity dam. Along the North side of the building a concrete apron has been built, sloping upward, the whole being securely tied to a series of wheel-pits to the south of it.

The ice rack is placed upon this apron and is divided into a series of bays, each bay supported by a series of trusses.

The whole of the rack structure is enclosed.

After passing through the racks the water enters the wheel pits and discharges through the turbines and draught tubes into the tailrace. The velocity of the water in the different sections is as follows:

With 60,000 H.P. load on the generators,

Velocity passing through intake	6.4	ft. per sec.
" entering racks	1.5	" "
" through racks	1.7	" "
" " wheel pit entrance	2.8	" "
" " turbine runners	20.	" "
" " neck of draught tube	8.	" "
" " " "	3.3	" "

Gates on roller slides are provided for closing off any wheel pit when necessary, these gates being motor operated and designed to open against the full head of water. Provision is also made for filling the pits by means of valves between the adjacent pits.

The present equipment of the power house consists of five 5200 H.P. Horizontal, double runner, Francis Type Turbines, running at 164 r.p.m., each connected to a 3000 K.W. 6600 volt, 3 phase, 60 cycle alternator.

The governors are of the oil relay type, each machine being equipped with its own oil pump and storage tank, provision also being made for inter-connection of the individual pumping units.

Excitation is provided by two water wheel driven excitors, consisting of 250 K.W., 150 volt generators, connected to 400 H.P. water turbines, running at 400 r.p.m., and one 150 K.W. motor driven excitor set.

The current is stepped up to 60,000 volts for transmission to the City by means of water cooled, oil immersed transformers, the present installation consisting

*Paper presented to the Manitoba Branch by J. G. Glassco, Manager, and E. V. Caton, Chief Engineer of the City Light and Power Deparment on Tuesday, May 14 18.

of two banks each being composed of three 3000 K.W. single phase transformers, and one 9000 K.W., three phase transformer. All transformers are connected in delta on both high and loss tension windings.

The local service is supplied by two 300 K.W. 3 Phase 6600 220/110 volt transformers.

The whole of the switching is electrically operated, and remote controlled from a central control board. Current for this control is provided by a 300 ampere hour secondary battery, and may also be taken from the field supply.

Four tank aluminum lightning arresters are installed on each of the two outgoing lines.

The power house will ultimately accommodate sixteen units. The wheel pits for the eight additional units are partly completed and act as a dam connecting the west end of the completed building to the west wing wall.

Access to the power plant is provided by a standard gauge railway, owned and operated by the City, which connects the power site with the C. P. R. line at Lac Du Bonnet, some 23 miles distant.

The power is transmitted to Winnipeg over a two circuit transmission line, constructed on a right-of-way owned by the City. The line consists of two circuits, each having three aluminum cables of an area of 278,600 *c.m.* The wires are carried on steel towers, both circuits on the one tower, and spaced six feet *equileral*, pin type insulators being used, except at the special crossings, etc. As a result of systematic inspection it was found that the existing insulators were showing signs of deterioration. Upon a careful investigation being made a large number of the insulators were found to have some of the petticoats cracked or punctured. It was therefore decided to re-insulate the whole line, and this is now being done.

The new insulator has several advantages over the old one, and shows the result of improvement in insulator design, since the first installation. It has a larger creeping distance, a larger ratio between puncture and flash-over test, and is designed with a view to obviating the trouble in the old insulator, which was due to mechanical deterioration, rather than electrical.

The towers are spaced at an average of 600 ft. apart, the longest span being 940 ft. The towers are alternately braced and flexible, except at dead ends, towers and special structures, where braced towers are used. The standard braced tower is 53′7″ high overall, and weighs 3,872 lbs. It is designed for the following loads:

Across the line..................	6,200 lbs.
Along the line...................	7,200 lbs.

the load being applied at a point on the cross-arm 43′ above the ground. The standard flexible tower is 47′7″ high (overall) and weighs 1,868 lbs. It is designed for the same transverse load as the braced, but only for 480 lbs. along the line. The above load represents a wind load of 1040 lbs. and 1200 lbs. per pin respectively.

The standard insulator pin consists of a two inch W.I. pipe and is good for a full load of 900 lbs. before sign of failure. On dead ends and other special work a two inch solid pin is used.

The joints in the cable are made by means of an 18″ eliptical sleeve.

The cable is attached to the insulator by a No. 2 B. & S. soft drawn aluminum tie wire, and sits on an aluminum saddle placed in the grooves of the insulator.

The line is transposed six times between Point du Bois and Winnipeg, making two complete spirals.

Sectionalizing towers are placed at four points on the line.

The right of way is sufficiently large to permit of another set of towers, carrying two additional circuits, being installed.

The Terminal Station, in the City, at which the power is received, is situated on the south bank of the Red River, in the North End of the City. The power is here stepped down to 12,000 volts, by three banks of transformers, each bank consisting of three 2700 K.W. S. P. O. I. W. C. transformers, connected in delta on both high and low tension windings.

The present building is large enough to accommodate two additional lines and transformers for same.

All of the switching is electrically operated, remote controlled, from a central switch board, the current for operation being provided by means of a storage battery and small generator set.

Aluminum lightning arresters are provided on each of the two 60,000 volt incoming lines.

In an annex are placed two 5000 K.V.A. synchronous reactors, which by means of automatic volt ageregulators maintain the required voltage in the City. This installation has been fully described in a previous paper and it is not proposed to go into their operation fully at this time. The machines are self-starting, oil pressure being applied to the bearings to assist in starting. These machines are used to regulate the voltage by changing the Power Factor of the load, and are capable of giving 6,000 K.V.A. in either lag or lead direction.

The water supply for cooling the transformers is supplied from three sources.

1st. From a cooling tower, located in the yard, adjacent to the station.

2nd. From the City Mains.

3rd. From the Red River—so that a constant supply is always assured.

The 12,000 volt current is supplied to substations in and adjacent to the City by overhead and underground feeders. There are at present installed seven underground feeders and one overhead feeder.

The City is supplied by these substations, located:

One at King St.
One at McPhillips, and
One in the Terminal Station Buildings.

These stations receive the power at 12,000 volts by means of lead covered, paper insulated cables, drawn into clay ducts, and transform it to 2300 volts for distribution throughout the City.

King Street, or No. 1 Sub., is the largest and most important. It supplies the main and downtown business area and the Fort Rouge district and also district South of the Assiniboine River. It is supplied by three

250,000 c.m., 12,000 volts, 3 core, paper insulated, lead covered cables.

The present equipment consists of:

Two 3000 K.W. Banks, each bank consisting of three 1000 K.W. S.P.O.I.S.C. 12000/2400 volt transformers; and one 1500 K.W. Bank, consisting of three 500 K.W. S.P.O.I.S.C., 12000/2400 volt transformers. All of the transformers are connected in delta on both high and low voltage windings.

There are also installed: Three 500 K.W. Motor Generator Sets, two of these sets consisting of synchronous motors connected to 500/250, 3 wire generators. The machines are started up by using the exciters as a starting motor, current being supplied for this purpose by means of a small motor generator set.

The third set is similar to the other two except that the synchronous motor is self-starting.

All of the switching with the exception of the D. C. feeders, is electrically operated, remote controlled from a gallery located along one end of the building.

Current for operation may be obtained from any of the exciters from the small standby motor generator set, or from a secondary battery.

Induction regulators are installed on most of the outgoing 2300 volt feeders.

All switches are mounted in concrete compartments, the 2300 volt switch being in the basement, the 12,000 volt on the main floor.

McPhillips or No. 2 Station is located at the corner of Logan Avenue and McPhillips Street, and supplies the west and part of the North End of the City.

It is supplied at 12,000 volts, by means of two 250,000 c.m. P.I.L.C. cables, pulled in underground ducts. There is also a 12,000 volt tie cable by means of which it can be tied in with King Street.

The present equipment consists of three 1500 K.W. banks of transformers, each bank consisting of three 500 K.W. S.P.O.I.S.C. transformers, 12000/2400 volts, connected in delta on both high and low tension windings. The 12,000 volt switch is remote controlled, electrically operated. Operating current is supplied by means of a storage battery or a small motor generator set.

The 2200 volt switching is remote controlled, hand operated, all switches being mounted in concrete compartments.

From this station two 12,000 volt overhead lines are run, one of which supplies the City Pumping Station and Stoney Mountain, the other the C. P. R. Shops. Each of these lines is protected by a 4 tank aluminum arrester.

There are also installed in this building, 30 constant current transformers for street lighting purposes.

No. 3 Substation is located in the Terminal Station building, and supplies the North End of the City and Elmwood District.

It is proposed to move this station to a separate building shortly.

The present equipment consists of a 4500 K.W. bank of three 1500 K.W. S.P.O.I.W.C. transformers, 12000/2400 volt, connected in delta on both high and low tension windings.

All of the switches are electrically operated, remote controlled, from a board situated on the main control gallery of the terminal station.

The distribution in the City is at 2200 volts. The majority of the feeders are three phase, three wire, although there are still several single phase feeders in use. Both power and light are taken from same feeders, although there are several feeders used only for power where the load warrants this. Induction regulators are installed on the majority of feeders.

The secondary distribution is all three wire, 220/110 volts for light and 500 volts, 3 wire, for power.

A large part of the down town district is supplied by means of an underground system. The cable is L.C.P.I. and is drawn into clay ducts of 3½" inside diameter. Separate manholes for transformers are provided. Duplicate feeders are run, and a special type of subway box is used so as to allow of the quick interconnection of feeders or isolation of faulty sections.

Each transformer manhole in addition to the transformers contains primary cutouts and a primary connection box, so as to allow of the transformer being cut into either feeder.

At several points disconnecting boxes are installed to allow of quick isolation of faulty sertion. The secondaries of the transformers feed into a distribution box where by means of links they may be parallel with other transformers or run on separate sections.

TRANSCONA.

The town of Transcona is supplied by means of a 12,000 volts, overhead line which leaves the Terminal Station. This line supplies the town by means of a substation containing three 500 K.W. S.P.O.I.S.C. transformers, connected in delta on both high and low tension windings, which stop the current down to 2200 volts for local distribution, also two 50 light constant current regulators for the street lighting.

The C. G. R. shops and elevator are also supplied by this line, the current being supplied in bulk at 12,000 volts, and being stepped down to 500 volts in two substations, owned and operated by the Railroad Authorities.

A branch from this line also supplies the town of Bird's Hill and the Golf Club, current being stepped down to 2200 volts in a small substation.

An interesting feature of this line is the induction regulator which controls it. The line, as originally built, was only intended to handle a few hundred kilowatts. Owing to the increased load, and particularly to the heavy load at low power factor pulled by the Government Shops, it became necessary to take steps to improve the regulation. After investigating the subject it was decided to install an induction regulator. The regulator was designed to give a 20% boost, no buck being required. It was also desirable to install such equipment as could be used for other purposes, should it, at a later date, be decided to install a substation adjacent to the High Tension line at Transcona.

The equipment consists of three parts, an autotransformer connected in series with the line, and giving a 10% boost, a 2200 volt, 3 phase, induction

regulator, capable of giving 10% of the line voltage when excited to 230 volts, and a 3 phase transformer which, when excited from the induction regulator, will give 10% of live voltage.

The latter transformer has its high tension winding connected in series with the line, and its primary exciters by the secondary of the induction regulator.

The primary of the induction regulator is excited by an additional winding on the auto-transformer giving 2200 volts. With the induction in its neutral position no voltage is induced in the second tranformer, and a straight 10% boost is obtained from the auto-transformer.

With the induction regulator on full buck the second transformer is excited so as to give 10% buck on the line, thus neutralizing the auto-transformers 10% boost and giving normal station voltage on the line.

With the induction regulator on full boost the second transformer adds 10% to the auto-transformers. 10% and 20% boost is obtained.

The results obtained have been extremely satisfactory, both from the financial and operating points of view.

At Saldo, on the transmission line, some 25 miles from the City, there is a small substation supplying power to the villages of Tyndall and Beauséjour. The equipment consists of three 100 K.W. O.I.S.C. S.P. Transformers, 60,000/12,000 V., connected in delta on both high and low tension windings.

The street lighting of the City is operated by the Light and Power Department. The lamps at present erected are:

D. C. Magnetite	1,562
" inverted	146
7.5 Amp. A. C. Enclosed	202
1000 c.p. series gas filled	974
100 and 250 c.p. series gas filled	130
60 and 100 Watt Multiple Incandescent	416
Total	3,430

The lamps are supplied from two points: May St. and McPhillips.

At May Street are installed 38-50 light mercury vapor rectifier sets for supplying the magnetite lamps. Current is supplied directly to this station at 2200 volts three phase. This station is used exclusively for street lighting purposes.

The remainder of the lighting is supplied from McPhillips Street Substation, where are installed 27 constant current regulators. The lighting is all on the all-night system—4,000 hrs. per year.

In addition to the above lamps the City operate 64 lamps in the outlying Municipality of Kildonan.

The distribution of losses over the year 1917 were as follows:

K. W. Hrs. delivered to the line at Power House 84,226,040	100%
K. W. Hrs. metered on consumers premises, 65,008,835	77.2%
Loss between Power House and Consumer	22.8%

This loss is distributed as follows:

Loss in line	6,100,190	7.24%
Loss in Condensers	2,243,400	2.66%
Used in City	3,008,846	3.56%
Distribution and Tansformation losses	7,864,781	9.35%
		22.81%

The loss between the Terminal Station 12,000 V. bus and the consumers meters is 10.8% of the K.W. Hrs. delivered to the 12,000 volts bus at the Terminal. Net 143 Flat Rate consumed.

Line losses include transformation losses from 6600 V. P.H. Hrs. to 12,000 V. Terminal bus.

The following statistics of the distribution system may be of interest:

Number of poles erected in City	11,279
Additional Joint Poles used by City	638
Pole Type Transformers	2,185
Subway Type Transformers	55
Transformers in Private Vaults	41
Total Capacity of Transformers	32,750 K.W.

Divided as follows:

Lighting consumers in City	33,883
A. C. Power consumers in City	514
Connected load per consumer in City—Light and heat	1,075 K.W.
Transformer capacity per consumer in City—Light and heat	67 K.W.
Connected load per consumer in City. A. C. Power	22 K.W.
Transformer Capacity in City A. C. Power	19.5 "
Total consumers on Whole System	34,793
Total connected load on System	56,000
Connected load per consumer	1.62

A Simple Method to Obtain the True Bearing of a Line*

By E. S. M. Lovelace, M.E.I.C.

The following table worked out for the years 1918-1924, giving in minutes the Azimuth of the North Star East or West of true north at the hours of 6, 7, 8 and 9 p.m. Local Mean Time, for the 1st and 15th day of each month, affords a direct and easy way of determining the true bearing of any line, as it is only necessary to measure the horizontal angle between such line and the North Star, note the time when the measurement is made, and then take from the table (interpolating where necessary) the azimuth which the star had at the particular time in question.

The *Table* as calculated, is correct to the nearest minute, and can be used for any longitude in North America, and for any latitude between 40 and 50 degrees.

While Land Surveyors are familiar with methods suitable for such work, they may find by using this table,

*Approved to be read at the Montreal Branch.

a simple way of establishing a true meridian, and convenient, in that the determination may be made at any time between 6 and 9 o'clock p.m. that the *star* happens to be visible, (no waiting up until some late hour for the elongation of the star).

It is however, for Engineers, who are not so often called upon, and not therefore so familiar with any approved method of making a determination, that the table is primarily intended, and for such, it is hoped, that this table and the following explanation will fill a long felt want, for quite apart from the desirability of giving *true* in place of *Magnetic* bearings on every plan of any importance, there is the further advantage that such determinations afford a ready means of checking up definitely the instrumental work on a traverse survey (or in connecting up surveys made by different men) in a way that, on account of lack of precision, local attraction, etc., *compass* readings can only approximately do.

Standard Time in the United States and Canada is the mean time at certain standard meridians of longitude:

Antlantic Standard time, is for longitude	60	degrees West of Greenwich.
Eastern " " " "	75	
Central " " " "	90	
Mountain " " " "	105	
Pacific " " " "	120	

As the standard meridians are 15 degrees apart, corresponding to one hour or 60 minutes in time, it follows that each degree of longitude corresponds to 4 minutes in time, therefore, if the place of observation be to the *East* of one of the above standard meridians, then, four minutes for each degree must be *added* to the standard time shown by the watch, to get the *local* mean time required when using the table. Similarly, if the place of observation be to the *West* of such standard meridian, the correction must be *substracted*.

If not already known, the *particular* standard time to which the watch is set can be ascertained readily from a railway time table: the watch itself need only be within three or four minutes of the correct time.

The longitude and latitude of the place of observation can be taken from a map, and need only be known approximately.

As an example of the use of the table, suppose that at place in longitude 72° 23′ and latitude 47° 36′ on October 27th, 1918, at 7.32 p.m. Eastern Standard Time, the horizontal angle between the North Star and a distant mark to the *West* of the star was measured and found to be 23° 17′; required, the *true* bearing of the line between the instrument and the distant mark.

As Eastern Standard Time refers to longitude 75 degrees and the place of observation is 72° 23′ equal 72.4 degrees, therefore, (75.0 – 72.4) or 2.6 degrees multiplied by 4 gives 10.4 or say 10 minutes is to be added to the standard time shown by the watch, which gives the *local* mean time of the observation 7.42 p.m.

Looking at the table:—On October 15th at 7 p.m. at latitude 40° the azimuth is 86′ and at 50° is 102′ therefore, interpolating for latitude 47° 36′ equal 47.6° it would be +98.2′. On November 1st at 7 p.m. at latitude 40° the azimuth is 75′ and at 50° is 89′ therefore, for 47.6° it would be + 85.6′, that is, in the 17 days elapsing between October 15th and November 1st the azimuth has changed from 98.2 to 85.6 a change of 12.6, so that for October 27th, or 12 days after the 15th, the change would be 12.6 x 12 ÷ 17 or 8.9, and therefore, the azimuth of the North Star at 7 p.m. on the 27th October is (98.2 – 8.9) or + 89.3′.

Similarly, by interpolation from the table it will be found that at 8 p.m. on the 27th October the azimuth is + 74.8′.

But the *local* mean time of the observation as already seen was 7.42 p.m. and therefore, as the change between 7 and 8 p.m. or the change in 60 minutes is (89.3 – 74.8) or 14.5, the change corresponding to 42 minutes would be (14.5 x 42 ÷ 60) or 10.2, and therefore the required azimuth of the star at the time of the observation would be (89.3 – 10.2) or + 79.1′ or say 1° 19′ to the *East* of true North, and therefore the bearing of the line between the instrument and the distant mark would be (23° 17′ – 1° 19′) or N. 21° 58′ W.

It will readily be perceived that if the observation had been taken at 7.50 p.m. instead of at 7.32 p.m. then the *local* mean time would have been (50 + 10) or 8 p.m. and more than half the work of interpolation would have been avoided. As this work, however, is really trifling and in most instances can be done mentally, it will usually be found better to measure the angle at ones leisure and simply note the time. It is not the easiest thing in the world in latitudes above 45° to get the star focussed in the field of vision and at the same time have the proper amount of illumination for the cross-hairs, and therefore, any attempt to force matters so as to secure a reading at a particular moment is to be deprecated as tending to invalidate the result.

To illuminate the cross-hairs, a reflector cap (which is simply a sunshade with a perforated reflector set inside at an angle of 45°) can be obtained from any instrument maker, or failing that, a piece of tracing linen can be wrapped around the object glass and held in place there by an elastic band; one side of the cylinder thus formed can then be bent inwards so that the light from a lantern held nearby by an assistant is reflected down the barrel of the telescope.

The distant mark may be a lantern placed behind a slit in a box, or better, should one be available, an electric light. In the latter case, the horizontal angle between the centre of the electric bulb and the survey line could be measured in daylight, either before or after the observation of the star.

In interpolating from the table, it is to be remembered, that, in 1920 and 1924, leap years, February has 29 days.

It should also be borne in mind, that, in case of any *daylight saving* being in effect, that *one* hour must be *deducted* from the standard time shown by the watch, before applying the correction for longitude, in order to obtain the *local* mean time.

Azimuth of North Star in Minutes

+ sign indicates North Star is East of true north.
— sign indicates North Star is West of true north.
Local Mean Time is STANDARD TIME shown by watch ± or a correction for Longitude of place of observation.

Date		1918 Local Mean Time 6 p.m.	7 p.m.	8 p.m.	9 p.m.	Lat.	1919
January	1	+ 19	— 5	— 28	— 49	40°	
"	1	+ 22	— 6	— 33	— 58	50	
"	15	— 3	— 26	— 48	— 66	40	
"	15	— 3	— 31	— 56	— 78	50	
February	1	— 28	— 50	— 67	— 80	40	
"	1	— 34	— 59	— 80	— 95	50	
"	15	— 48	— 66	— 79	— 87	40	
"	15	— 57	— 78	— 94	—103	50	
March	1	— 65	— 79	— 87	— 89	40	
"	1	— 77	— 93	—103	—105	50	
"	15	— 78	— 86	— 89	85	40	
"	15	— 92	—102	—106	—101	50	
April	1	— 87	— 89	— 84	— 75	40	
"	1	—103	—105	—100	88	50	
"	15	— 89	— 85	— 76	— 62	40	
"	15	—105	—101	— 90	— 73	50	
May	1	— 85	— 75	— 61	— 42	40	
"	1	—100	— 89	— 72	— 50	50	
"	15	— 76	— 62	— 44	— 22	40	
"	15	— 90	— 74	— 52	— 26	50	
June	1	— 60	— 41	— 20	+ 3	40	
"	1	— 71	— 49	— 23	+ 4	50	
"	15	— 43	— 22	+ 1	+ 23	40	
"	15	— 51	— 26	+ 1	+ 28	50	
July	1	— 20	+ 2	+ 24	+ 45	40	
"	1	— 24	+ 3	+ 29	+ 54	50	
"	15	— 0	+ 23	+ 44	+ 62	40	
"	15	— 0	+ 27	+ 52	+ 74	50	
August	1	+ 25	+ 46	+ 64	+ 77	40	
"	1	+ 30	+ 55	+ 76	+ 92	50	
"	15	+ 45	+ 63	+ 77	+ 86	40	
"	15	+ 53	+ 75	+ 91	+101	50	
September	1	+ 64	+ 78	+ 86	+ 89	40	
"	1	+ 76	+ 92	+102	+105	50	
"	15	+ 77	+ 86	+ 89	+ 85	40	
"	15	+ 91	+102	+105	+101	50	
October	1	+ 86	+ 89	+ 85	+76	40	
"	1	+102	+105	+101	+ 90	50	
"	15	+ 89	+ 86	+ 77	+ 63	40	
"	15	+105	+102	+ 91	+ 74	50	
November	1	+ 85	+ 75	+ 61	+ 41	40	
"	1	+100	+ 89	+ 72	+ 49	50	
"	15	+ 77	+ 62	+ 43	+ 21	40	
"	15	+ 91	+ 74	+ 51	+ 25	50	
December	1	+ 61	+ 42	+ 20	— 4	40	
"	1	+ 73	+ 50	+ 23	— 4	50	
"	15	+ 44	+ 22	2	— 25	40	
"	15	+ 52	+ 26	2	— 29	50	
"	31	+ 21	— 3	— 26	— 48	40	
"	31	+ 24	— 3	— 31	— 57	50	

To be copyrighted.

Twelfth Annual Convention of the Western Canada Irrigation Association

To be held at Nelson, B.C., July 24th, 25th and 26th, 1918.

The Engineers from both sides of the Rocky Mountains in Western Canada are looking forward with a great deal of interest to the Convention of the Western Canada Irrigation Association, to be held at Nelson, B.C. July 24 to 26th. The interest in this Convention will readily be understood by all the Western men who are familiar with Irrigation, know of the development work which has already been done, and realize the future development and improvement that will certainly take place in the future irrigation work. The Eastern men probably are not familiar with this great work, and it may be of interest to them to realize that in the Province of Alberta, in the districts adjacent to Calgary, Medicine Hat, and Lethbridge, the Canadian Pacific Railway Company now control irrigation enterprises representing a capital cost of nearly twenty million dollars. These projects contain about 700,000 acres of irrigable land. The Canada Land & Irrigation Company is developing a project near Medicine Hat which will water about 200,000 acres. Scattered about the two Provinces of Alberta and Saskatchewan there are a large number of small private developments aggregating in all about 100,000 irrigable acres.

In the interior of British Columbia irrigation is perhaps even a more vital enterprise than it is in the Western prairie provinces.

There have been a great number of developments through the Okanagan country, the Columbia Valley, in the Kamloops district, and in the Kootenay country. The developments have all been successful from an engineering view point, but many of them are in very serious difficulties financially. The objects of the Western Canada Irrigation Association are:—

"(1) To promote and diffuse knowledge concerning irrigation and other uses of water throughout Western Canada.

(2) To facilitate conference and deliberation among the people of the country concerning irrigation and related interests.

(3) To provide means for bringing the needs of the people and the country before the Provincial and Dominion Governments."

The Association has already gained a very enviable record, and has obtained the confidence of the Western people who are interested in irrigation. There have been numerous instances where small irrigation farmers had difficulties that required some concerted action, and in such cases the Association has always come forward, and in many cases been able to exert that influence which was required to stir government or corporation interest and remedy the existing difficulties.

This Conference is always a Mecca for the irrigation engineers in the West, and this year with the meeting at Nelson where so many attractions are held out in the way of beautiful scenery, splendid bathing and boating, and cherries galore, there is no question that the Convention will be one of the most enjoyable and successful that has ever been held.

THE FIRST CANADIAN ENGINEERS

Two splendid specimens of the pioneers in engineering work in this country are now located in the library of the Institute at Montreal. King George might have received them but the Institute was given the preference.

Thanks to the generosity of S. J. Chapleau, M.E.I.C., district engineer, Department of Public Works, Canada, and to the genuine public spiritedness of the Ottawa branch the Institute now has what may be justly termed a rare possession in the form of two of the finest specimens of beaver in existence. The illustration showing them in their case gives merely an indication of what splendid specimens they really are. The white beaver, a true albino, is one of the rarest of all fur bearing animals and is remarkable for its size and the quality of its coat.

The First Engineers

Members of the Institute will take pride in the possession of these beavers and they will give added interest to the new crest, when designed, which by authorization of the annual meeting is to typify a beaver at work. Although the final design for the crest has not yet been adopted, it is anticipated that it will be one at the same time satisfactory to the members and a credit to the Institute.

The beavers were a present from Mr. Chapleau and the Ottawa branch had them set up in the framed glass case which they occupy.

A brief history of these beavers was kindly forwarded in a letter from Mr. Chapleau in which he states: "Some years ago I had occasion to arrange the distribution of flow in the Rainy River past the Fort Frances, Ontario International Falls, Minnesota Section, in order that the Canadian Side would receive the benefit of its share, or one-half of all power generated there by the operating Companies, and during my stay at Fort Frances I greatly admired a pair of stuffed beavers, one black and one white, that I thought, if properly arranged together, would look well as a group illustrating "The First Engineers", after a picture that I had seen of like nature. I tried to buy the beavers at the time with the idea of sending them to the Main Society at Montreal, but was unable to do so, and expressed my ideas in that regard to Colonel D. C. McKenzie, then Mayor of the town.

About one and a half years afterwards, much to my surprise, Dr. McKenzie sent me down two mounted beavers which are now in the case, asking me to accept them as a gift from himself and other friends of the town, so I turned them over to our Branch with the request that they be sent on to Headquarters.

On enquiring for a mounted white beaver Dr. McKenzie found none were to be had, but learned from an old trapper that there was one on a lake in the Atikokan District, who trapped the same next Winter at Dr. McKenzie's request.

The 141st Battalion, the 'Bull Moosers', which was raised for Overseas Service by Dr. McKenzie as its Colonel, wished to take these specimens with them to England and present them to the King, but the Doctor preferred to carry out his original intention.

They were mounted here by Mr. Petch who does all that kind of work for the Dominion Museum."

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOL. I. NO. 3 JULY 1918

Second Professional Meeting

The second professional meeting of the Institute will be held at Saskatoon on August 8th, 9th and 10th where an interesting session will be held and important papers presented, dealing particularly with the engineering problems of the Prairie Provinces. The Manitoba, Saskatchewan, Calgary and Edmonton Branches join in extending a cordial invitation to all who can possibly do so to attend.

The success of this meeting is already assured.

Council is particularly desirous that the energy and enthusiasm of the men in the West be given loyal support.

All who expect to be present at this important gathering are requested to so advise J. N. deStein, Secretary-Treasurer of the Saskatchewan Branch, 2130 Retallack Street, Regina, Sask., in order that he may make arrangements for hotel accommodation.

Maritime Profession Meeting

The third professional meeting for 1918 has been arranged to be held in Halifax on Wednesday, Thursday and Friday, September 11th, 12th and 13th. In another column will be found under Halifax Branch News, an account of the minutes of the Executive Committee of the Halifax Branch, which includes a tentative programme of the professional meeting.

On account of the hotel situation in Halifax it is earnestly requested by the officers of the Halifax Branch that all who are planning to attend, notify K. H. Smith, Secretary-Treasurer of the Halifax Branch, 197 Hollis Street, Halifax.

Professional Unity

The spirit in which the first issue of the journal has been received, as evidenced by letters from every part of Canada, would indicate that the Journal can be made a factor in developing the interests of the profession and advancing the welfare of its members. This is not going to be accomplished, however, unless every man feels a sense of duty in making some personal effort for the cause. Every man in the Institute, from the latest student to the oldest charter member, has a definite sphere of activity in the responsibility of making the Journal a success.

Some of us think of the recognition of the profession and the increased status of the engineer as some vague, indefinable thing that may be achieved in some miraculous manner, forgetting that accomplishment has not been reached because the will to accomplish has lain dormant in the minds of so many instead of being spurred into action. The greatest possible effort that has been made in the past and is still being made by the willing few falls short of the goal because this is a matter requiring the concentrated effort of every one whose interests are at stake.

Let us all resolve to give some personal service to the profession we represent; to take an active constructive interest in the development of our organization; to contribute, by way of suggestion and sending in items to the Journal of personal doings or any other matters of interest to the general membership; to become a committee of one to interest others in the Institute who are eligible for admission and on every and all possible occasions to impress those not in the profession with what engineers are really accomplishing.

Procedure for Admission or Transfer

The length of time taken before an application for admission or transfer has gone through the prescribed routine is a matter of misunderstanding and sometimes of criticism. It is evident that in the minds of many a rather hazy idea exists of what is done when an application is received at headquarters, and consequently a brief summary of the course followed would not be out of order.

Briefly, when an application for admission reaches the Secretary's office, an abstract is made for the next preliminary list and the sponsors immediately commucated with. It often happens that sponsors are given who are not members, requiring the submission of additional names. The preliminary list is issued immediately after Council meeting so that the names thereon may be considered at the next meeting of Council. It very often happens, however, that when the next meeting of Council arrives, replies have not been received from a sufficient number of sponsors, the regulations requiring five. This means that the lack of one reply may hold an application up for one or several months. When replies are not received from sponsors within a reasonable time, a second form is sent, followed by a third and often up to a fifth. Any one can see that this involves not only a great amount of unnecessary work at headquarters but a needless delay in having an application considered, *consequently all are urged to return reference forms immediately when received*, containing the information requested, if possible. In many cases applications are referred to the Branch, at which the applicant is resident, for advice, it being necessary sometimes to secure information not given by the sponsors. Educational qualifications are verified.

If the applicant's education is not of university standard the application is referred to the Board of Examiners and Education for report. This Board meets periodically and considers all applications referred to it, advising what examination it is necessary for the applicant to take. When an examination is required the application is held until the following period when examinations are held, these being the first Tuesday of the months of November and May. On an examination being required the applicant must successfully pass the prescribed examination before his classification is considered by Council. In all other cases a sufficient number of sponsors having replied the application comes before the Executive Committee, which goes exhaustively into all details given in connection with the application, recommending to Council the grade for which the applicant is qualified. At the next meeting of the Council the application is again considered and a classification agreed upon. The name then goes on the Ballot which is sent to all members of Council immediately after the meeting at which the classification is made. This is Ballot opened at the following meeting of Council, when, if there are not more than three votes against the applicant, he is declared elected. He is immediately advised of his election. If the election is not accepted within six months it becomes void.

For transfer the prodecure is practically the same as for admission.

Imperial Mineral Resources Bureau

At its meeting in London on the 23rd of April, 1917, the Imperial War Conference passed the following resolution:—

> "That it is desirable to establish in London "an Imperial Mineral Resources Bureau, upon "which should be represented Great Britain, "the Dominions, India, and other parts of the "Empire.
>
> "The Bureau should be charged with the "duties of collection of information from the "appropriate Departments of the Governments "concerned and other sources regarding the "mineral resources and the metal requirements "of the Empire, and of advising from time to "time what action, if any, may appear desirable "to enable such resources to be developed and "made available to meet the metal requirements "of the Empire."

Subsequently the Imperial Minister of Munitions of Great Britain, acting under the direction of the War Cabinet, set up a special committee representative of the governments of Great Britain and of the Dominions, to suggest the constitution and prepare a scheme for establishing the Bureau. This Committee has recommended:—

(1) That a new organization should be set up and be known as the Imperial Mineral Resources Bureau.

(2) That its offices should be in a part of London convenient to the interests concerned.

(3) That the administration of the Bureau should be controlled by a Governing Body representative of the Governments of the Empire and also of the commercial interests directly concerned in the mineral, mining, and metal industries—trade co-operation being essential to the success of the Bureau.

(4) That the following should be the duties of the Bureau:—

- (a) To collect, co-ordinate, and disseminate information as to resources, production, treatment, consumption and requirements of every mineral and metal of economic value.
- (b) To ascertain the scope of the existing agencies with a view ultimately to avoid any unnecessary overlapping that may prevail.
- (c) To devise means whereby the existing agencies can, if necessary, be assisted and improved in the accomplishment of their respective tasks.
- (d) To supplement those agencies, if necessary, in order to obtain any information not now collected which may be required for the purposes of the Bureau.
- (e) To advise on the development of the mineral resources of the Empire or of particular parts thereof, in order that such resources may be made available for the purposes of Imperial defence or industry.

This Bureau has since been established and the Dominion of Canada has appointed as special Canadian representative, Dr. W. G. Miller, mineralogist of the Ontario Government, Toronto.

There is one feature of the organization of the Bureau to which it might not be out of place to draw the attention of the engineering profession. The total representation of the Advisory Board consists of twelve members. Seven of these members are direct appointees of the British Government, five are from the outlying Dominions—Australia, New Zealand, South Africa, Canada and Newfoundland. Some of these five at least are more likely to be politicians than well informed technical men. Newfoundland, which is not more important from a mineral standpoint than one of our larger provinces, is given the same representation and has the same voice in the affairs of the Board as has Canada. The entire Board is "loaded" strongly from a British point of view. Unquestionably the whole effort of British organizations after the war will be to secure various raw materials from these Dominions for the purpose of manufacturing them in Great Britain and re-selling the manufactured products in the Dominions and in other markets which are equally accessible to manufacturing concerns in the Dominions themselves. In other words, the main purpose of this Bureau appears to be that of an advisory body for the benefit of British manufacturers, and its activities in certain lines may be rather detrimental to the interests of the Dominions unless these interests are carefully guarded.

* * *

Remarkable Water Power Development

Figures giving the amount of water power developed in the Province of Quebec make a remarkable showing and are an evidence of the enormous advancement that has taken place in the Province of Quebec in hydro-electric operation. This information was kindly submitted in a letter from the Deputy Minister of the Department of Lands and Forests of Quebec, which reads:

Dear Sir,

You will, no doubt, be interested to know of the result attained by the Hydraulic Service of this Department in an investigation on water-power development in the Province.

Leaving aside, for the time being, nearly all the plants under 1,000 H.P. capacity, on account of the greater difficulty to reach them, the figures already in, give a total of 810,000 H.P. developed.

We have reasons to estimate that once the smaller plants counted, the grand total will reach 850,000.

A detailed statement showing developments for each river will likely be given out a little later.

Yours respectfully,

(Signed) ELZ. MIVILLE DECHENE,
Deputy Minister.

* * *

Personals

Stanley H. Frame, A.M.E.I.C., formerly District Hydrometric Engineer, Irrigation Branch, Department of the Interior, Calgary, has been appointed Assistant Engineer, Department of Natural Resources, Canadian Pacific Railway, Brooks, Alta.

* * *

Major William Thomas Wilson, A.M.E.I.C., who has been in the thick of the fighting for several years with the Royal Engineers, has been awarded the military cross for exceptional bravery in action.

FUEL ADMINISTRATOR FOR MANITOBA

Thomas R. Deacon, M.E.I.C., who holds the post, is former Mayor of Winnipeg. He is President of the Manitoba Bridge and Iron Works, Ltd.

* * *

Increased Salaries for Railway Civil Engineers

In the United States the Railway Wage Commission have recommended increases in salaries of Technical Engineers, ranging from 16 to 37% and averaging 33%, which is the first general substantial salary increase that Railway Civil Engineers have ever had according to "Engineering and Contracting", Chicago. The salaries of draftsmen and inspectors have averaged $90 a month, and instrumentmen have averaged $100. These three classes comprise 90% of the technical men employed in the engineering departments of railways. Draftsmen and inspectors will receive $123, and instrumentmen $132 a month. Assistant and resident engineers receiving $125 will be raised to $153; and division engineers receiving $150 will be raised to $175.

These increases are substantial, and will be very welcome to thousands of engineers. Yet they serve to give the average technical engineer a salary scarcely more than that of a skilled mechanic, and considerably less than that of a locomotive driver.

Report of Council Meeting

Official change of name noted. Engineering Standards Committee. Professional meetings at Halifax and Ottawa. Greetings to Past President, Geo. A. Mountain. Elections and transfers.

The regular monthly meeting of the Council was hled at the headquarters of the Institute on Tuesday evening, June 25th.

J. M. R. Fairbairn gave a verbal report for the Committee appointed by Council to advise the Government in connection with changes in the Inspection and Sales Act, with particular reference to the weight of the standard sack of cement.

The Executive Committee which had held three meetings since the previous meeting of Council, presented a lengthy report of matters brought to the attention of the Executive.

Inasmuch as official notice that the Government had changed the name, had been received since the previous meeting of Council, it was recorded on the Minutes that the change had been effected.

Engineering Standards Committee: It was recommended and approved that the request of the Engineering Standards Committee recently organized under the chairmanship of Sir John Kennedy, that the Committee be allowed to make its headquarters in the building of the Institute and that the Secretary of the Institute act as Secretary of the Committee.

Special B. C. Committee: A Committee consisting of the chairman of the Victoria Branch and the British Columbia Councillors of the Institute was appointed to investigate and report to Council in reference to an application previouslv presented to Council requesting that certain members of the Institute be disciplined for their connection with the B. C. Engineering & Technical Institute.

Renewal of Fire Insurance: The arrangements made by the chairman of the Finance Committee and the Secretary in having the two former policies of $2,000 each on the contents of the building merged into one policy of $4,000, were approved.

Secretary's Bond: It was noted that the bond for $10,000 on the Secretary in favor of the Institute had been received by the chairman of the Finance Committee.

Paper's Committee: The chairman of the Paper's Committee was advised to arrange to have the chairman of the Maritime Branches added to this Committee as a temporary arrangement until the wording of the By-laws could be changed.

A voluminous Budget of correspondence dealing with various matters of interest to the Institute were noted, which included several expressions of appreciation of the Western Branches of the arrangements which resulted in Geo. F. Porter's lecture on the Quebec Bridge at the various Branch headquarters.

Leonard Medal: The suggestion contained in letter received from Lt.-Col. R. W. Leonard in reference to the regulations concerning the Leonard Medal, was adopted and the Secretary was instructed to amend the regulations accordingly.

Maritime Professional Meeting: Approval was given to hold a Professional meeting of the Institute in Halifax in the early Fall and the Secretary instructed to so advise the Maritime Branches in order that they might make immediate arrangements for drawing up a program and other details of the meeting.

Professional Meeting at Ottawa: In response to a request from the Ottawa Branch authority was given for holding a general Professional meeting of the Province of Ontario in the City of Ottawa in 1919.

Presentation of Beavers: The Secretary was instructed to write thanking the Ottawa Branch and S. J. Chapleau for their splendid gift to the Institute in the form of two of the first Engineers — a brown and a rare white Beaver — suitably mounted in a large glass case, and which were placed in the Library at Headquarters.

Greeting to Geo. A. Mountain: The meeting of of Council learned with a great deal of pleasure that the Past-President, Geo. A. Mountain, had been restored to health after a long illness and that he had resumed his position as Chief Engineer, Board of Railway Commissioners for Canada, and consequently instructed the Secretary to write Mr. Mountain expressing Council's pleasure that he had been restored to health and enabled to assume his former duties.

The Classifications for admission and transfer as recommended by the Executive Committee were, after full discussion, approved, and the Secretary instructed to issue the ballot for next meeting of Council.

Elections: The result of the ballot showed the following elections:

Members: Maj. Kay Alexander, of Vancouver, B.C., who previous to enlistment for overseas was superintendent of construction and chief engineer, with Grant Smith & Co. He is at present Major and second in command 12th Canadian Railway Troops, France. John Elliott Brown, of Ottawa, Ont., formerly chief engineer of Consumers Electric Co., of Ottawa, at present general manager Ottawa Hydro-Electric Commission. Geo. M. Colvocoresses, of Humboldt, Ariz., U.S.A., at present general manager of Consolidated Arizona Smelting Co., and consulting engineer for Ohio Copper Co., and Nicu Steel Corp. Ltd. Chester B. Hamilton, Jr., B.A.Sc., of Toronto, Ont., owner of the Hamilton Gear & Machine Co., Toronto.

Associate Members: Stanley A. Button, of Verdun, Man., has for a number of years been on the Manitoba Good Roads Board staff and is at the present time district engineer. Fred Henry Kester, of Walkerville, Ont., designing engineer for the Canadian Bridge Co. Ltd. Ernest Horace Longley, of New Westminster, B.C., is chief engineer for the Imperial Ministry of Munitions, General Car plant, Montmagny, Que. Ernest Arthur Markham, of Regina, Sask., supt. of Construction, Carsons Construction Co., Regina. Claude Melville Walker, B.Sc., of Ottawa, Ont., formerly in charge of party on investigation of water area and stadia surveys, at present in Topographical Surveys Branch, Dept. of Interior, Ottawa.

Junior: John Patrick Mooney, B.Sc. of St. John, N.B., civil engineer and in managerial capacity for B. Mooney & Sons, contractors and manufacturers.

Transfers. Associate member to member: Raoul de B. Corriveau, B.Sc., of Ottawa, Ont., district engineer Public Works Dept., directing, investigating and reporting on matters pertaining to the control, regulation and improvement of rivers and harbors and making special investigations outside of district. Robert Bruce Stewart, B.Sc., of New Glasgow, N.S., manager and engineer, Maritime Bridge Co. Ltd., New Glasgow, N.S.

Junior to Associate Members: Wm. Ernest Bomm, of Toronto, Ont., asst. engineer, Dept. of Public Works, Canada, on the Toronto Harbor Improvements. Fredk. Matchorn Brickenden, of London, Ont., formerly asst. city engineer of London. In 1915 enlisted as engineer officer with the Canadian Engineers and is at present on active service in France.

Student to Junior: Stanley Alexander Neilson, of Westmount, P.Q., resident engineer, Hull Electric Co., Hull, Que.

Ottawa Branch News

J. B. Challies. M.E.I.C., Associate Editor.

Dominion Topographical Surveys. Will History Repeat Itself? Civil Service Appointments by Merit Now. International Waterways Co-operation. Western Editorial Appreciation. Personals.

Dominion Topographical Surveys.

Only those who have, during the last half century, watched the development of the country, and its history in the making, can realize the full significance of the work done by that branch of the Dominion Government which has been engaged in carrying out the surveys of the Dominion lands, or place a true estimate on the share it has taken in this development.

When, in 1868, control of the North-West Territories passed from the Hudson's Bay Company to the government of the Dominion, little was known of the topography, soil, climatic conditions or natural resources of the newly acquired Territories. It is true it had been explored by hunters and the traders of the Hudson's Bay Company but information of value in inducing immigration or in developing the country was practically unknown. In assuming control of the new Territories therefore it became one of the first duties of the government to provide for its proper development and administration.

As it was known in a general way that the new Territories, or portions of them, were suitable for agricultural purposes, the primary consideration was to devise or adopt some system under which the country could be rapidly and accurately subdivided into farm holdings, and by means of which at the same time detailed information respecting the soil, natural resources, and other information of economic value could be procured.

To fulfill these requirements the Topographical Surveys Branch came into existence first as a branch of the Department of Public Works and later under the departments of the State and the Interior; for nearly fifty years the surveys of this Branch have preceded and given direction to the efforts of other civilizing influences, and the history of these surveys is in a large measure the history of the development of the Canadian North-West.

The system of survey adopted at the outset, was a modified form of one which had previously been applied to portions of the United States where climatic and other conditions were very similar. Among the modifications we find the banishment of the compass and a clause requiring all lines to be surveyed astronomically. From the outset precision in the surveys was aimed at and as means and circumstances permitted methods have been perfected.

In accordance with the system adopted, control lines consisting of initial meridians, base lines and block outlines were first surveyed, and upon this framework the subdivision of the land into sections and quarter sections was based.

For many years it was a struggle to keep the surveys in advance of settlement. In order to do so it was necessary in one year alone (1883) to subdivide an area of 27,000,000 acres, in addition to the survey of 11,300 miles of governing lines. This is equivalent to a subdivision into farm holdings all ready for settlement, of an area only slightly less than that of the whole of England.

Since 1885 this work has been uninterruptedly under the direction of E. Deville, I.S.O., LL.D., D.T.S., F.R.S., whose rare abilities for scientific and executive work have been applied with tireless energy to the administration of these surveys with a view to securing the greatest possible accuracy at a minimum cost to the country. Under his direction means have been taken to bring the system of survey, the instruments used, and the surveys themselves as nearly as possible to perfection. Special instruments have been provided for the survey of the control lines, and a Surveys Laboratory which in appointment compares favourably with the finest in America has been established and has been in use for several years for the purpose of testing and obtaining corrections for the instruments used on the surveys.

The system of control lines, surveyed up to the present time, although confined to the provinces of Manitoba, Saskatchewan and Alberta, extend from the Interprovincial Boundary to tide-water on Hudson Bay, and westerly to the Rocky Mountains. Among these control lines are the longest straight lines which have been surveyed in any country in the world and it is noteworthy that in a system extending over such immense areas the geographic positions of the monuments on these control lines are known with an accuracy which furnishes the government with all that is needful or desirable in the way of control for mapping or administrative purposes, within the areas covered by these surveys.

As an instance of this accuracy, some of the circumstances connected with the surveys of the most

recently located base lines might be cited. In the spring of 1917 a base line party left their initial point, the north-east corner of township 108 on the Fifth Meridian, and commenced the survey of the 28th base from this point to the Fourth Meridian, 144 miles east of their starting point. All through the summer the party cut their way through the bush over a country which made survey operations very difficult, towards their objective point on the Fourth Meridian, varying their course where required by the system of survey, and taking their direction solely from the stars. When, towards the end of the season the Fourth Meridian was approached, and the axemen had cut through the last few rods of bush, the line they had surveyed from the Fifth Meridian was found to intersect the Fourth Meridian only twelve feet from the post which formed their objective point. Nor is this case an exception, but rather the rule.

For the purpose of further checking the positions of points on these lines, a series of latitude observations of extreme precision were taken with the zenith telescope at a number of points throughout the surveys during the years 1911, 1912, 1914 and 1915. From the results of these observations, and accurate survey connections, a careful computation has recently been made of the latitudes of points throughout the entire system of governing lines.

On this framework the subdivision surveys are based. These in January 1917 covered an area of approximately 178,602,141 acres, exclusive of the surveys in the Railway Belt. This means the subdivision of an area practically equal to the combined areas of France and Italy. The monuments on these subdivision lines, being referenced over comparatively short survey lines to the monuments on the control lines, it follows that their positions are also accurately known.

In 1887, it became necessary for administrative purposes to map some portions of the mountainous districts of Alberta and British Columbia. Here the regular subdivision methods of survev were not suitable and the ordinary topographic methods were too slow and too costly. The terrain appeared to be suitable for the phototopographic method which had been tried experimentally in Europe. Dr. Deville investigated and developed the method. It proved so successful on Dominion Land Surveys that it was later adopted on the Canadian Boundary, Canadian Geological, United States Coast and Geodetic, and United States Geological Surveys. It is now well known the world over and is generally accepted as the best and most economical method for rough and mountainous country. Dr. Deville's book "Phototopographic Surveying" is recognized as the standard text book on that subject.

In townsite surveys, contours and other topographic features are first obtained. From these the location of parks, directions of streets, and other details of the prospective town are planned in such a way as to combine artistic effect with utility. The townsites of Banff and Woodhaven are good examples of modern town-planning.

The great areas over which the Dominion land surveys have been extended, the accuracy with which they have been performed, the wealth of information of great economic value obtained during the surveys, and the impetus which all these has given to the development of the country are without parallel in the history of any other country, and call attention to them as being the most remarkable of their kind in existence.

Will History Repeat Itself?

Leading journals of our large cities, especially Montreal, Toronto and Winnipeg, have been devoting considerable time and energy to the preparation of argument in favour of the location by the Dominion Government of the national railway headquarters, in their respective cities. Toronto papers point out that the headquarters of the Canadian Northern Railway has always been there and if removed, many of its citizens would be thrown out of employment; furthermore, as the public ownership and operation sentiment has not penetrated farther east than central Ontario, the headquarters of the national railways should be somewhere west of Montreal. Montreal papers point out that the headquarters of the Canadian Pacific Railway has always been in Montreal, and as the headquarters of the Grand Trunk Railway is also in Montreal and it is probable this road will be merged with the Canadian Northern Railway and the Canadian Government Railways, it would be in the interest of efficiency and prevent much dislocation and re-arrangement if the headquarters of all Canadian railways were established in that city. Winnipeg papers advance typical western reasons why the headquarters should be located in the metropolis of the Prairies.

Surely there can be little doubt about the advisability of locating the headquarters of all Dominion Government railway systems at the Capital of the Dominion. So far Ottawa editors have not taken part in this very interesting controversy, perhaps they wisely remember how Bytown was selected by Queen Victoria, as the Capital of the Dominion and re-christened Ottawa, after the proclaimed advantages of all other municipalities in the Dominion were given due consideration.

Civil Service Appointments by Merit Now.

The recent appointment of J. M. Wardle, A.M.E.I.C., formerly Highway Engineer with the Dominion Parks Staff, to the position of Superintendent of Rocky Mountains Park rendered vacant by the death of Mr. S. J. Clarke, is one which will be received with considerable interest and satisfaction by the engineering public.

Mr. Wardle is but 30 years of age, a B.Sc., of Queen's University, and has been engaged on road construction work in the Dominion Parks for the past four years. Since the enlistment of Major A. W. Gray, who went overseas in 1915, he has acted as Chief Highway Engineer. Prior to his appointment in the parks service he was engaged in mining and railway surveys and municipal and railway construction engineering. His work in the Parks has included the construction of the Banff-Vermilion and Castle-Lake Louise sections of the new transmontane motor Highway which traverses Rocky Mountains Park as well as the construction of all roads and trails in the different national parks.

In addition to important departmental administrative duties, the position of Superintendent at Banff involves the supervision of large construction works for which Mr. Wardle's engineering training and experience will be of great value. This is a case where "the job" has sought the man, and his colleagues in the Ottawa Branch extend to Mr. Wardle hearty congratulations on his appointment, and best wishes for his further progress.

International Waterways Co-operation.

R. J. Burley, M.E.I.C., International Waterways Engineer, of the Irrigation Branch, Department of the Interior, left Ottawa on June 3rd to take charge on behalf of Canada, of the field work in connection with the measuring and apportioning of the waters of the St. Mary and Milk rivers and their tributaries, between Canada and the United States, under the provisions of the Waterways Treaty. Mr. Burley is associated with B. E. Jones, of the U. S. Geological Survey in this work. These two engineers are acting under the directions of E. F. Drake, Superintendent of Irrigation, and A. P. Davis, Director and Chief Engineer of the U.S. Reclamation Service, who have been appointed administrators of these waters for their respective countries. A number of interesting hydrometric engineering problems with regard to seepage losses, winter measurement of streams, etc., will have to be solved in the near future.

Mr. Burley will officially represent the Ottawa Branch at the Twelfth Annual Convention of the Western Canada Irrigation Association to be held at Nelson, B.C., on July 24th, 25th and 26th.

Western Editorial Appreciation.

A recent editorial from the "Calgary Canadian" so well portrays the attitude of the occupant of the average newspaper editorial sanctum towards technical Government reports generally, and so clearly exhibits the advisability of a little judicious education of such writers regarding the necessity for hydrometric or similar investigations and the proper use of the results therefrom, that it is repeated herewith not only for the amusement, but for the serious consideration of Journal readers.

Truly the "dog days" are on in the West and the mania for originality in rendering advice and assistance has caused our western scribe to exhibit a lack of appreciation and an amount of ignorance which it is hard to believe exists in an Editor, especially one from the province of Alberta where precipitation and runoff records are about as common subjects of consideration and discussion as is the weather in other parts of the Dominion. The editorial in question has, however, a saving sense of humor and for this reason alone it is worth repetition.

Almost every other day there is received from one or other of the government officials a blue book, or report of some nature or other. They cover a wide range of subjects all the way from raising silk-worms to the proper way to control hogs; from growing potatoes to spraying trees, or from the number of acres under cultivation to the number of stars in the sky. There is nothing in the sky, or under the water, or upon the earth that the government has not apparently got a band of devoted men working on, probing and wrenching, calculating and experimenting. Then every month or year they descend or emerge as the case may be, and present a fat report to the Deputy Minister, who in turn passes it on to the Minister, who yawns tremulously and finally gets it fobbed off on the Governor-General. He, not having much time to read, sends it to the King's Printer and he finally sends it off to a long-suffering public.

These reports are very useful, for information contained in them works into the warp and woof of our daily life, and makes life generally more easy and comfortable. Today we felt a sting of self reproach when we turned to fire the book into the usual receptacle. It seemed too bad, after all the hours of toil and trouble to make these books that no one should read them—and did you ever see a press notice of one? Never! So we will do the decent thing and give them a little notice. The book received this morning was one on the cultivation of roses, and this was laid by for future reference, when we start that Italian rose garden. The other one, a fearsome volume containing many pages and a map, is the report of the British Columbia Hydrometric Survey. Quite an appropriate name. The book is well gotten up (as reviewers say) and is closely printed, so the reader will have plenty to digest. As the name implies, it is all about water, so it would make an excellent addition to the library of a total abstainer, or for any of us for that matter. The author takes the reader into every place in British Columbia where there is any water, carefully avoiding the saloons, and tells, in picturesque language, all about the gauging stations, the rivers, lakes and water-falls. There are some splendid columns of figures, containing exciting details of the area of section, mean velocity, discharge, drainage and precipitation. There are several dams scattered through the book, which gives it a racy flavor. Unfortunately, the love element is left out, and if the Department could have worked a woman into it, it would have lots more readers. Anyway, the hero is living happily yet, for the last we read of him he was busy taking discharge measurements of the Kicking Horse river. As for the villain, a glimpse is caught of something about a dam and a log jam, so he likely got entangled in that, and died uttering muffled curses. However, get the book for yourself, and pass a quiet hour with nature.

(From "Calgary Canadian".)

Personals

Lt.-Col. T. Victor Anderson, D.S.O., has been recently gazetted Commandant of the Engineers' Training Corps in Seaford, England, and graded Assistant Director of Signals. Col. T. V. Anderson is one of four sons of our own Col. W. P. Anderson, C.M.G., Chief Engineer of the Department of Marine, all of whom have already served with distinction in His Majesty's forces overseas.

* * *

Wm. H. Onken, Jr., Editor of the Electrical World, New York, came up to Ottawa to attend the annual meeting of the Canadian Electrical Association. Few men are better posted generally with regard to the water power situation on this continent than Mr. Onken and his expressed optimism for the future of power development in Canada is significant.

* * *

Lieutenant V. M. Meek, A.M.E.I.C., who was wounded last October while serving with the 2nd Tunnelling Company in France, has returned to his home in Port Stanley, Ontario, where he is slowly recovering. There is prospect of his shortly being able to resume his civil duties but his wounds will not permit him to return to military life. He was before enlisting on December 11th, 1916, a valued member of the engineering staff of the Irrigation Branch of the Department of the Interior, and it is expected that he will again enter the service of that Branch as soon as he is physically fit.

* * *

R. S. Stronach, A.M.E.I.C., Dominion Parks Branch, Dept. of the Interior, who was invalided home from France last fall, suffering from gas poisoning, has been discharged from the military service as medically unfit. He has now been transferred to the west as Resident Engineer at Jasper Park, Alta.

Halifax Branch

Meeting of Executive Committee

K. H. Smith, Associate Editor

The Committee met at 5 p.m. Monday 8th July at Room No. 34 Telephone Building. Those present were: F. A. Bowman, H. Donkin, W. P. Morrison, P. A. Freeman R. McColl.

In the absence of the Secretary, the Chairman acted in his place.

The minutes of the last meeting were read and approved.

The chairman announced that eighteen of the members of the Nova Scotia Society of Engineers resident in Halifax had filed their applications for admission to the Institute and two more were known to be applying. It is hoped to get three more who have not yet applied. This makes the membership to date:

Existing members	38
Applying from N. S. Society	20
New members	6
Total	64

A letter from the Secretary of the Institute was read, which authorized the holding of a general professional meeting in Halifax this Fall. After some discussion the following provisional programme was drawn up:

Suggested Outline of Programme for General Professional meeting, Engineering Institute of Canada, Halifax Branch, at Halifax, N.S.

September 11th, 12th and 13th.

WEDNESDAY

Morning Session

9.30 a.m.—Opening of Meeting.—Address of Welcome from Lieut. Governor, N.S. Address of Welcome from Mayor, Halifax, N.S.

10.00 a.m.—Business, if any.
10.30 to 1 p.m.—Papers.
1 p.m.—Lunch at Green Lantern, 50c. each.

Afternoon Session

2.30 p.m.—Auto trip, Terminals and Devastated Area.

6.30 p.m.—Tea at Waegwoltic.

THURSDAY

Morning Session

9.30 to 1 p.m.—Papers.
1 p.m.—Guests at luncheon—Commercial Club.

Afternoon Session

2.30 to 4 p.m.—Papers.
4.00 p.m.—Excursion on Harbour.

Evening Session

8.00 p.m.—G. F. Porter, New Quebec Bridge.

FRIDAY

Morning Session

9.30 a.m.—Papers.

Afternoon Session

Excursion.

The following Committees were appointed with power to add to their numbers;

Papers.—J. L. Allan, A. J. Barnes, J. W. Roland; to co-operate with the St. John Branch and the "Papers" Committee of the Council.

Entertainment.—L. H. Wheaton, P. A. Freeman, R. McColl.

Transportation and Hotels.—W. P. Morrison, F. H. MacKenzie, J. R. Freeman.

In view of the fact that F. W. W. Doane, M.E.I.C., has just returned from the Front to take up again his duties as City Engineer, it was decided to hold a luncheon meeting of the Branch on Monday 15th July to welcome him.

Vancouver Branch

Lecture on Quebec Bridge. Special Committee considering Registration. Membership of Committee.

A. G. Dalzell, A.M.E.I.C., Associate Editor.

More than 400 people crowded oval room of the Hotel Vancouver on the evening of Friday, June 7th, to hear Geo. F. Porter give his now famous lecture on the Quebec Bridge. Interest was added to the occasion by the presence of the hotel orchestra which played a few selections before the commencement of the lecture. Although there were a large number of laymen present, Mr. Porter's description of the erection of the bridge, together with the splendid collection of slides, held the audience in a very attentive and appreciative attitude. Owing to the lateness of the hour when the lecture was concluded there was no discussion. Prof. E. G. Matheson, chairman of the branch, occupied the chair and introduced Mr. Porter in a few well chosen words and also put the vote of thanks in the same happy manner.

At our last executive meeting a special committee was appointed to draft up an outline to place before the next general meeting, of our views and ideas on the Calgary resolution regarding registration; this committee consisted of the members of the executive with the addition of C. E. Cartwright, A. B. Weeks and G. T. Hamilton.

Another special committee was appointed to encourage applicants to join the Institute and it is intended that this committee will endeavor to round up as many men as possible, particularly the junior members of the profession.

This committee was subdivided into three sections in order to deal with the different classifications of membership and was as follows: Students: W. H. Powell, H. K. Dutcher and E. G. Matheson. Junior and Associate members: A. B. Weeks, L. H. Kennedy and C. Brakenridge. Associates of Branch: C. E. Cooper, C. E. Cartwright and R. F. Hayward (chairman).

The Institute is to be congratulated on the splendid edition of the first issue of the Journal which will mean a good deal to the Institute and especially to the branches.

St. John Branch

Geodetic survey of the Bay of Fundy co-operating for Maritime Professional meeting.

A. R. Crookshank, A.M.E.I.C., Associate Editor

The St. John branch is now fully organized and is at present considering plans for the coming fall and winter session. In the meantime the officers of the branch are co-operating with the Halifax branch to make a splendid success of the Maritime professional meeting which Council has authorized to be held in Halifax this fall. The interest in engineering matters in this province has been greatly increased during recent months and although the membership of the St. John branch is not large, the men in this branch are confident that its activities will work to the advantage of the standing of the engineering profession.

In prosecution of its plans for a geodetic survey of the upper reaches of the Bay of Fundy the Dominion Government has just completed on Shepody Mountain, in Albert County, New Brunswick, near the bay shore about 25 miles south of Moncton, an observation tower. This is the fourth of a series of five towers to be erected preparatory to the commencement of the survey. The first one was built at Green Mountain, near St. Martins, in St. John County; the second at Hastings, near Alma, in Albert County, both in New Brunswick; and the third about 7 miles from Parrsboro, in Cumberland County, Nova Scotia. The fifth tower will be built at Salem, Cumberland County, Nova Scotia, about 7 miles from Amherst.

Victoria Branch

Geo. F. Porter lectures on Quebec Bridge.

E. G. Marriott, Associate Editor.

The most noteworthy event in the recent history of the Victoria branch was the visit of Geo. F. Porter, engineer of construction of the Quebec bridge, to the branch on June 12th. The meeting was held in the high school and was largely attended by many outside the profession. In the absence of R. W. McIntyre, chairman of the Victoria branch, D. O. Lewis, member of council Victoria, presided. As has been the case at other centres where Mr. Porter lectured, his illustrated talk was a revelation to his audience, who listened to his lecture and formed an added respect for the profession, members of which designed and directed so remarkable a structure. At the conclusion of the meeting Mayor Todd of Victoria moved a vote of thanks which was seconded by City Engineer Rust, M.E.I.C.

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W. K. Gwyer, M.E.I.C., who has for some time past resided in Victoria has recently been appointed District Engineer to the Public Works Department of the Provincial Government with headquarters at Penticton, B.C., where he has taken up his residence.

Wm. Young, M.E.I.C., Comptroller of the Water Rights Department for the Provincial Government of British Columbia has been appointed to the Executive of the Victoria Branch to succeed Mr. Gwyer.

J. M. R. FAIRBAIRN, Montreal.
Vice-President, E.I.C.

Chief Engineer Canadian Pacific Railway System

News of the honor that has come to J. M. R. Fairbairn, vice-president E.I.C., in his appointment as chief engineer of the Canadian Pacific Railway System will be received with the heartiest approval by all who know Mr. Fairbairn, whether in the engineering profession or otherwise. The position of chief engineer of the greatest transportation system in the world represents a proud pinnacle in engineering positions and that it should come to one who is yet comparatively a young man, does him all the greater credit. The official announcement of Mr. Fairbairn's appointment states that it is the result of sterling service rendered the Company since he joined it in 1895. Mr. Fairbairn was born in Peterborough 45 years ago. Two years after graduating from Toronto University in 1893, he joined the C.P.R. as draftsman in Winnipeg, and since then promotions have come to him in rapid succession. He was resident engineer at Place Viger, Montreal, assistant engineer, Toronto, assistant engineer of maintenance of way, Montreal, division engineer, Toronto and engineer of maintenance of way, Montreal, leading to his appointment as assistant chief engineer in 1911.

With his usual modesty Mr. Fairbairn declined to talk for publication. All members of the Institute will join with the *Journal* in extending heartiest congratulations.

The Honorary Advisory Council for Scientific and Industrial Research

Abstract of the Report of the Administrative Chairman.

On Friday, May 17th, 1918, Sir George E. Foster, Minister of Trade and Commerce, tabled in the House of Commons the report of the Administrative Chairman of the Honorary Advisory Council for Scientific and Industrial Research. This report, which deals with the measures that have been taken and the plans that are being laid to place Canadian science and industry upon a sure footing, must necessarily be of great interest to the Canadian public, and the officers of the Council take great pleasure in calling to the attention of the Canadian Public a few of the salient features.

On June 6th, 1916, there was constituted, by Order-in-Council, a Sub-Committee of the Privy Council, consisting of the Rt. Honourable Sir George E. Foster, Minister of Trade and Commerce (Chairman), and the Honourable the Ministers of the Interior, Agriculture, Mines, Inland Revenue and Labour. This Sub-Committee had for its object the creation of measures to foster the scientific development of the industries of Canada in order that during and after the present war they may be in a position to supply domestic needs and enable Canada to compete successfully in world markets.

The Sub-Committee of the Privy Council created, on the 29th of November, 1916, an Honorary Advisory Council for Scientific and Industrial Research. This Council referred to briefly as the Research Council, is composed of eleven representatives of the scientific, industrial and business interests of Canada. Its personnel is, as follows:

Administrative Chairman: A. B. Macallum, M.A., M.B., Ph.D., Sc.D., LL.D., F.R.S., Ottawa.

Secretary: Lesslie R. Thomson, B.A.Sc., A.M.E.I.C., Ottawa.

Honorary Recording Secretary: J. B. Challies, C.E. (Tor.), M.E.I.C., Superintendent, Dominion Water Power Branch, Ottawa.

Members:

F. D. Adams, Ph.D., Sc.D., LL.D., F.R.S., Dean, Faculty of Applied Science, McGill University, Montreal.

Tancrede Bienvenu, Esq., Vice-President and General Manager, La Banque Provincial du Canada, Montreal.

R. Hobson, Esq., President, Steel Co'y of Canada, Hamilton, Ont.

S. F. Kirkpatrick, M.Sc., Professor of Metallurgy Queen's University, Kingston, Ont.

J. C. McLennan, O.B.E., Ph.D., F.R.S., Professor of Physics and Director of the Physics Laboratory, University of Toronto, Toronto, Ont.

A. S. Mackenzie, Ph.D., D.C.L., President, Dalhousie University, Halifax, N.S.

W. C. Murray, M.A., LL.D., President, University of Saskatchewan, Saskatoon, Sask.

R. A. Ross, Esq., E.E. (Tor.), M.E.I.C., Consulting Engineer, 80 St. Francois Xavier Street, Montreal.

R. F. Ruttan, M.A., M.D., Sc.D. Professor of Chemistry and Director of the Chemical Laboratories, McGill University, Montreal.

Arthur Surveyer, Esq., B.A.Sc., M.E.I.C., Member of the Board of Directors of the Ecole Polytechnique, Montreal, Consulting Engineer, 274 Beaver Hall Hill, Montreal.

The duties of the Research Council are briefly:—

(a) To ascertain and tabulate the various research agencies in Canada.

(b) To note and schedule the researches and investigations which are being carried on at the present time.

(c) To co-ordinate all research agencies so as to prevent over-lapping.

(d) To tabulate the technical and scientific problems that confront the present industries.

(e) To study the unused natural resources of Canada and the by-products of all basic industries.

(f) To increase the number of trained research men.

(g) To stimulate the public mind in regard to the importance and utility of scientific research and its application.

The first meeting of the Council was held on December 4th, 1916, and it was decided to carry on the work by means of an Administrative Chairman who would devote all his time to the prosecution of the work, and to this end Professor A. B. Macallum of the University of Toronto was elected.

A few months later the Council was constituted a permanent organization by a Federal Act, which received Vice-Regal signature on August 29th, 1917. It is in virtue of this Act that the Council is now operating under the direction of the Sub-Committee of the Privy Council.

In order to carry out its various functions, the Council has been active, during the period under review, in organizing for the promotion of research in Canada, and with that object it has already taken a number of interesting measures, which are briefly outlined below:—

Studentships and Fellowships

To maintain the supply of scientific experts available for service in the Canadian industries, the Council has founded, with the approval of the Sub-Committee, a number of studentships and fellowhips of value $750 and $1,000 each, respectively, to be awarded to university

graduates or others, who possess the necessary qualifications required in those who aim at a career in scientific or industrial research. The holders of these appointments may prosecute their investigations at any approved Canadian university, and each may be re-appointed if the results of his work are reported to be of sufficient value as a contribution to science to warrant the continuation of the study.

Assisted Researches

In addition to the studentships and fellowships above mentioned, the Council also has provided a fund to assist research on industrial processes and methods, especially those which involve the utilization of by-products. Ten of these grants, ranging in amounts from $250 to $5,000, have already been awarded.

One of these, which is of special interest to the public, is the investigation on tar fog. This has to do with the solution of the problem of conserving economically the products of the destructive distillation of wood, coal and the liquid products created during the manufacture of producer gas, etc. To demonstrate this matter, a plant on a commercial scale was established at Sault Ste. Marie, in connection with the coke works of the Algoma Steel Corporation, Limited, and, as a result of experiments conducted by Dr. J. G. Davidson, the process demonstrated clearly that a great effort should be made to recover the products of the destructive distillation of wood and tar, for these can be separated from steam and gas at a high temperature by an application of the Cottrell process in such a manner that subsequent evaporation and treatment of the water mixture can be avoided. This process will probably be utilized by several of the Canadian distillation plants in the near future.

The research on straw gas involves the practical utilization for heat and light on the farms of the prairie provinces of the enormous quantities of straw, estimated at 20,000,000 tons, now being burned in order to dispose of it.

The results of fog signalling experiments forecast the use of a new type of sirens for use in the River St. Lawrence and the Gulf.

The studies on the disposition of sulphite liquor waste of our Canadian pulp mills, enormous in quantity, now poured in the streams and rivers, poisoning all fish life therein, are giving results which seem to point the way to the commercial utilization of, at least, the sugars they contain in order to furnish alcohol for industrial purposes. A further note on this question is listed among the activities of the Associate Committee on Chemistry.

The necessity for investigation on the production of a rust-resisting wheat is found in the fact that, annually, more than $20,000,000 are lost through the prevalence of the rust disease in Manitoba, Saskatchewan and Alberta, and a research into the question has been initiated.

Associate Committees

To assist in the solution of individual problems under existing conditions, the Council has appointed Associate Committees composed of experts from the various parts of the Dominion, usually under the Chairmanship of a member of the Council; one on Chemistry, to report and advise on problems in industrial chemistry; one on Mining and Metallurgy, to deal with the outstanding questions regarding the mining and mineral industries and resources of Canada; one on Forestry, to investigate our forest resources and recommend scientific action for their conservation; one on Cold Storage, to develop the scientific application of cold storage principles to our Canadian industries; and another on Flax Fibre, the functions of this last Committee being to investigate and report upon the possibility of the growth in Canada of large quantities of best quality flax.

Chemistry Committee

These Committees have been indefatigable in the discharge of their duties, and the below-mentioned activities (selected from a much larger list) of the Associate Committee on Chemistry, of which Dr. Ruttan is the Chairman, may give some idea of the service that the Research Council is rendering to the national life of the country.

Utilization of Fish Waste.—Fish waste in Canada amounts to over 300,000 tons per annum, of which perhaps half is available for conversion into nitrogenous and phosphate fertilizers and as a protein food for cattle, hogs and poultry. The Council is engaged upon a thorough survey of this question, and will shortly be in a position to make recommendation touching the establishment of industries.

Industrial Alcohol from Wood Waste.—The Imperial Munitions Board in November last called the attention of the Research Council to the desirability of stimulating production of Ethyl Alcohol from sources other than food grain, two of which be profitably utilized in Canada, viz: the utilization of wood waste and the fermentation of the sugar found in the sulphite liquor waste from pulp mills.

The former is likely to prove very economical in B.C. where large supplies of sawdust are available throughout the whole year, while the latter might be established at any of the Eastern Canadian pulp mills. Negotiations are at present being carried on in view to the establishment of this industry. This last, however, has only been urged after careful experimentation has been made both by the Laurentide Paper & Pulp Company, and by the Associate Committee on Chemistry in the laboratories of McGill University.

The Utilization of Scrap Leather.—The waste per annum of scrap leather in Canada is about 2,000 tons, and special studies are under way to determine its economic utilization.

In addition to these researches on the part of the Associate Committee on Chemistry, a large number of inquiries on specific problems and difficulties encountered by the industries in their ordinary operations have been submitted and answered. A list of these questions comprises three pages of the report, which will give some idea of the assistance given by this Committee to industrial enterprises throughout Canada.

The Flax Committee, under the Chairmanship of Dr. Ruttan, after a careful investigation which covered the need for flax fibre for airplanes and the suitability of Canadian climatic conditions, recommended that every

effort be made to increase the acreage for 1918 of the flax grown in Eastern Canada. Mr. Grisdale, the Director of the Central Experimental Farm, was asked to represent the urgency of the situation to the Flax Growers Association, a meeting of which body took place in March. As a result of these efforts Mr. Grisdale reports that the acreage sown in Eastern Canada in 1918 may be 14,000 as compared with 8,000 sown last year, but this will be partially dependent upon the availability of seed and labour.

Special Problems

The Council has also been engaged on a number of special problems, three of the most interesting of which are the utilization of the Western lignites, the restoration of the Sockeye Salmon Fisheries, in the Fraser River District and the research on Forestry. The importance of the lignite question may be indicated in a few sentences. The Provinces of Manitoba and Saskatchewan import annually from Pennsylvania about half a million tons of anthracite for domestic fuel, and send out of the country, therefore, more than $4,000,000. There are in these provinces, it is estimated, about 57 billion tons of lignites of a poor grade and, consequently, disqualified from serving as domestic fuel. It has been demonstrated, however, that they can be carbonized and briquetted and that the product thus treated is an equivalent of anthracite. As a result of these investigations, conducted by the Lignite Committee, of which Mr. R. A. Ross of Montreal is the Chairman, the Council recommended that the Government establish a plant in Southern Saskatchewan to turn out 30,000 tons of this fuel yearly, the estimated cost of which would not, probably, exceed $7.00 per ton at the plant. The three Governments concerned are about to sign the proposed agreement, the Dominion Government having already voted its share of the total cost of the plant. The Governments expect also to appoint the Commission to operate the plant very shorlty.

The Special Committee on the Fraser River Salmon Question was appointed to consider the measures to be taken to preserve the supply of Sockeye Salmon. Urgent representations had been made to the Research Council by the B. C. Canners' Association and other organizations in that Province, in regard to the fish industry, which stated that the reckless, and even criminal over-fishing in the international waters of the Straits and at the mouth of the Fraser River had reached such a point that the complete extinction of the industry was imminent. The question had become acute last year owing to the failure in the run of the Sockeye, and, in consequence, all parties on both sides of the international boundary were ready to arrange an agreement as to the measures to be taken to ward off the threatened danger. After serious consideration, the Committee, under the Chairmanship of Dr. Prince, stated, among other things, that the danger had been due, chiefly, to over-fishing with traps, seines and nets, so numerous that only a very small proportion of the fish ever reached the mouth of the Fraser River to spawn in its waters, and recommended that an agreement to limit this fishing should be made, in the form of a treaty, between the United States and Canada. After full consideration of the report of the Committee, the Council recommended that negotiations for such an international agreement be undertaken, and also arrangements for the early publication of the special report of this Committee. The matter now rests with the Government.

Forestry

The Forestry situation in Canada, especially in the East, is such that the exhaustion in the near future of our forest resources cannot be regarded as a negligible prospect, and the measures necessary to meet this danger must be taken at the earliest moment. Such measures, of course, must be determined only after definite information has been obtained regarding the rate of reproduction and growth of Canadian forest trees, especially of the various commercial species. Regard should also be paid to the available supply of sawlog and pulpwood material. Owing, practically, to a complete lack of knowledge on this point, the Governments and private owners had been in the habit of treating these forest areas and limits as if they were mines instead of crops. The Council has, therefore, set itself to study this question as one which must be solved from the point of view of an annual yield to be permanently sustained. The necessity for this can be appreciated when it is realized that at the present time Canada's total timber wealth could not supply the present sawmill capacity of the United States for more than twenty years. At present the Commission of Conservation has done some valuable work on the timber question in British Columbia and Nova Scotia, but, so far, there is practically no data on the rates of reproduction and growth, under home conditions, of the great majority of the forest trees in the East and middle sections of Canada.

In view of this situation, the Forestry Committee, in conjunction with the Forestry Branch of the Department of the Interior, made certain recommendations regarding extensive studies of the whole question, and, in conjunction with the Director of the Forestry Branch, Mr. Campbell, determined that a forest survey should be made over a portion of the lands comprising the Petawawa Military Reserve, and during the months of August and September of 1917 a party, directed by Mr Campbell's Department, but under the assistance of the Advisory Council, made the preliminary investigations. The Council proposes to continue this work during the open season of 1918.

Research, its Inventory and Development in Canada

In order to comply with paragraph (a) in the list of duties assigned by the original Order-in-Council, the Research Council endeavoured to made a survey of the present situation as regards scientific research and the equipment and man power for the same in Canada. To this end questionnaires were addressed to all the Universities, Technical Institutions and Societies, Government Departments and to several thousand industrial firms and organizations. The return of these questionnaires is not yet complete, but enough information has been gathered to demonstrate the grave situation in which Canada finds herself to day as a result of lack of men trained for scientific and industrial research.

During the past fifty to one hundred years modern science was comparatively undeveloped and in its evolutionary stage, and the universities and higher educational institutions, generally, were devoted almost wholly to literary learning, from the dominant influence of which they are, by no means, yet free. In Canada there are today eighteen universities, and, in the main, they are not yet exerting their main educational effort into scientific branches. Not one of the four or five Faculties of Applied Science is older than forty years, and though several of these have done excellent service so far as their staffs and equipment go, they cannot be expected to compete with institutions like the Massachusetts Institute of Technology, or others of a similar character, in the United States. The annual budget of the Massachusetts Institute of Technology, alone, exceeds the total of the annual expenditure of all the Faculties of Applied Science in Canada.

The apathy regarding the claims for greater assistance for Applied Science Faculties is due to the fact that public opinion in Canada has not been educated to the point of conceding the principle, that science, pure and applied, is as vital a concern of the State as its national safety. These remarks apply not only to the ordinary Canadian public opinion, but also to the great majority of the Canadian industries. There are, however, a few who are far sighted enough to see the urgencies of the measures that must soon be taken to meet the impending crisis.

Owing to the scattered geographical situation in Canada, which applies as truly to its industries as to its railway problem, and owing to the high cost of industrial research, it is becoming more clearly seen that Trade Associations, or Guilds, must soon be founded by certain groups of related industries, in order to pool their expenses and, at the same time, gain, in common, the resulting benefits.

To any individual industry in such a Guild, some of the advantages may be briefly stated, as follows:—

(a) The right to recommend specific problems for research, which, if approved, will be carried out without cost to the firm recommending the problem.

(b) The right to periodical information in regard to the technical development of the industry.

(c) Right to the use of patented or secret processes which might be developed from the researches.

These Guilds, or Associations, might be financed either completely by the industries forming them or, partially so, the balance being made up by the Governmental support in some form or another. Suggested groups of the Canadian industries concerned might be mentioned, as follows: The Tanners' Association, The Paint and Varnish Assoc., The Textile Assoc., The Pulp and Paper Assoc., and the Clay Products Assoc.

From a perusal of these suggestions it will be quite evident that, while a number of industries in any one group may be competing for business, yet their mutual interests are sufficiently important to warrant them spending a reasonable amount in order to gain the great advantages that the applications of science undoubtedly confer.

The relation of these Guilds to a possible Central Research Institute in Canada is discussed in the Report, and the prototype for such a suggestion may be seen in the Mellon Institute at Pittsburgh, founded and endowed by the Mellon Brothers in 1911. As an example of the service which that Institute has rendered, the American Bread Company, as a result of a research initiated and supported by the Institute, has already reduced the cost of one of its Departments by a sum more than equivalent to the cost and equipment of the whole Institute.

Finally, it may be noted that the realization of the importance, nay, necessity, for the creation and application of research is becoming universal throughout the world. Research Institutes of one type and another are to be found in the United States, Great Britain, France, Japan and Germany, which indicates as clearly as anything could possibly do, the absolute unanimity of informed public opinion the world over as to the absolute urgency of the present situation. Therefore, let Canada be prepared, or the pitiless competition that will assuredly follow in the years to come will find her lagging far behind in the race for an assured industrial prosperity, which, in turn, is essential if this Dominion is to attain her high destiny.

Two Charter Members Pass Away

Thomas Breen, M.E.I.C.

On May 27th, one of the oldest and most respected civil engineers in the Province of Quebec in the person of Thomas Breen, M.E.I.C., passed away at the age of seventy-nine years.

For the past forty-eight years, Mr. Breen who was educated at Laval University, has been in the employ of the Dominion Government, occupying the position of District Inspecting Engineer of Public Works of Canada at the time of his death. On account of his retiring disposition Mr. Breen was better known to the past generation than to the present. He was a splendid type of an Irish gentleman, yet a true Canadian and took a deep interest in the country's welfare. For many years he has been a member of the Board of Examiners under the Quebec Act and at all times took an active interest in the welfare of the engineering profession. He is survived by Mrs. Breen.

Henry Carre. B.A., M.E.I.C.

The engineering profession of Canada lost one of its oldest connecting link with the early days of pioneer railway engineering in the death, on July 11th, of Henry Carre, at his home in Belleville in his 85th year.

During his long and useful life he was closely identified with the development of Canada and being on the engineering staff of the Canadian Pacific Railway, and assisted in the engineering work of building the road to the Pacific Coast. He was present on the occasion when the last spike was driven, signalling the completion of the road.

Few men in Canada had more friends than Henry Carre whose kindly disposition, courtesy and charity made life better and brighter for many.

During the Fenian Raid excitement, the late Mr. Carre was a member of the militia and proceeded with his company to Prescott for active service.

The funeral took place from the family residence, 276 Albert St., Belleville, to Christ Church where the services were conducted, on Friday, July 12th.

Mrs. Carre, one daughter and four sons survive him.

Inspecting the Newly Opened Trent Valley Canal

Information concerning the opening of the Trent Valley Canal was given in the last issue of the Journal. It is now open between Lake Simcoe and Lake Ontario bisecting a vast area of Central Ontario. At the opening the notable engineers seen in the above photograph made a journey over the new waterway on the steamer "Loretta". Left to right: W. A. Bowden, M.E.I.C., Chief Engineer, Dept. of Railways and Canals; Lt.-Col. Monsarrat, M.E.I.C., Consulting Engineer, Dept. of Railways and Canals; A. T. Phillips, M.E.I.C., Supt. Engineer, Rideau Canal; A. L. Killaly, M.E.I.C., Supt. Trent Canal; D. E. Eason, M.E.I.C., Principal Asst. Engineer Trent Canal; A. J. Grant, M.E.I.C., Supt. Engineer Trent Canal.

Personals

Geo. A. Johnson, M.E.I.C., consulting engineer, 150 Nassau Street, New York, has been commissioned a Major in the Quartermaster Corps, National Army, U.S.A. Major Johnson will be attached to the construction division, maintenance and repair branch, with headquarters at Washington, D.C.

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Henry Stewardson, A.M.E.I.C., heretofore Assistant City Engineer, New Westminster, B.C., has been appointed City Engineer, succeeding Lieut. J. W. B. Blackman, M.E.I.C., who has resigned to accept a position under the military Government as Director of Fortification and Works in the Aviation Department.

J. G. Sullivan, M.E.I.C., Chief Engineer Western Line, C.P.R., has retired from his position and will enter private practise. His outstanding experience in railway engineering matters will place him in an authoritive position in this line.

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M. LaForest, A.M.E.I.C., deputy inspector of fuses, cartridge cases and complete rounds Imperial Ministry of Munitions, Ottawa, has been appointed liason officer between Col. W. E. Edwards, director of inspections, Canada, Gen. Kenyon, director of inspection, U.S.A. and the Ministry of Munitions—inspection—London, Eng. Mr. LaForest left for London early in July, his present address being I.M. Y2 Ministry of Munitions, 8 Northumberland Avenue, London, Eng.

EMPLOYMENT BUREAU

A Clearing House of Engineering Position in Canada.

This department is one of the features by which it is hoped to be of greater service to the engineer and particularly the younger men. Firms and individuals requiring engineering assistance will have their inquiries listed in this department. Those out of employment or desirous of a change are invited to make use of it, without charge and in confidence.

Earning Capacity of Technical Men

A recent communication received by the Secretary takes up a point bearing on the present status of the technical man in regard to his earning capacity or more correctly, in regard to the attitude of others to the value of his services, and is one which no engineer can afford to ignore, for if this situation does not concern himself it vitally affects many to whom he owes a certain amount of professional responsibility. The letter states:

I have just received a copy of the Canada Gazette, dated the 1st June, 1918, in which certain advertisements appear for technical officers of the department. It occurred to me that in view of the interest you have taken regarding the awakening recognition of the engineer, that it would probably interest you to learn of the salaries being offered to the technical man in the Government.

You will observe that a technical clerk is required for the Topographical Surveys Branch, who is a graduate in Applied Science, Honour Mathematics or Physics, and is offered the ridiculous salary of $1,300 per annum. Another advertisement is for twenty-five draftsmen in the Department of Public Works, who are offered $1,600 per annum.

Another advertisement is for a law clerk in the Auditor General's Department who is offered $2,100 per annum. Another advertisement is for a moving picture camera man for the Department of Trade and Commerce, who is offered $2,400 per annum. You will notice that the highest salary offered is to the moving-picture man whose education has probably cost him very little. You will also notice that the technical clerk or the engineer, who is an honour graduate in mathematics, is offered only $1,300 a year. Even the law clerk is offered less than the moving-picture man.

With such discrepancy between the salaries of technical and non-technical men there does not appear to be much encouragement for young men to take the engineering course at any of our universities.

These matters may be of interest to you, and I therefore let you have the information so that some good use may be made of it. If I can obtain a copy of the Canada Gazette referred to I will send you a copy of same.

Yours for better salaries,

AN ASSOCIATE MEMBER.

Situations Vacant

Superintendents.

Two superintendents wanted for manufacturing plant, who will have general supervision of the plant, one for night and the other for day; must have had experience in handling men and mechanical and electrical experience. These positions offer splendid opportunities. Address applications to Box No. 1, Employment Bureau.

Mining Engineer.

Position is open for a junior engineer to commence as surveyor with a large mining corporation in northern Ontario. This position offers good prospects. Address applications to Box No. 4

Mining Chemist.

Mining chemist capable of making assays of all minerals and of looking after the chemical requirements of a mining corporation. Address applications to Box No. 5.

Works Engineer.

One capable of taking off accurate quantities for mechanical equipment from engineers' drawings and who has a fair idea of the cost of various machine shop operations, pattern making, and the installation of steam lines, shafting and general mill equipment. This position offers $130.00 to $150.00 per month to start and promises a good opening later. Address Box No. 8.

Mechanical Draftsman.

Wanted for large industrial company, mechanical draftsman with technical education and a few years experience, one who is quick and energetic and capable of designing. State qualifications, experience and salary expected, to Box 9.

Inspectors.

Three inspectors for dock construction, pile driving and concrete work, and one timber inspector, required by Steel Corporation. In writing, give experience, salary expected, age and standing in regard to military service. Apply Box No. 10.

Draftsman.

Draftsman for railway office in New Brunswick. A young man who is willing to work his way upwards. Apply Box No. 11.

Instrumentman.

At once, competent instrumentman wanted for Canadian Government Rlys. Apply Box No. 12.

Draftsmen.

Wanted by large shipbuilding corporation, competent draftsmen for structural, mechanical and marine work. This work is important from a military point of view and offering liberal terms. Only first class men wanted. Apply to Box No. 13.

Engineers for Construction.

A large contracting company having taken on several new contracts requires a number of engineers of construction, men with experience in engineering construction. Apply Box No. 14.

Instrumentman.

An experienced instrumentman wanted, preferably a young university graduate, for the Engineering Department of a railway company in Quebec Province. Address Box No. 15.

Institute Committees for 1918

EXECUTIVE COMMITTEE OF COUNCIL

H. H. VAUGHAN, Chairman
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PROGRAMME OF THE SECOND GENERAL PROFESSIONAL MEETING, SASKATOON

FIRST SESSION.

3 p.m., Thursday, August 8, 1918.

GOOD ROADS

3.00 P.M. **Opening Address** — Dr. W. Murray, President, University of Saskatchewan.

3.10 **Location, Construction and Maintenance of Earth Roads**—H. R. MacKenzie, A.M.E.I.C., Chief Field Engineer, Province of Saskatchewan, Highway Dept.

3.35 **Manitoba's Experience**—A. McGillivray, A.M.E.I.C., Highway Commissioner of Manitoba.

3.45 **Alberta's Experience**—J. D. Robertson, A.M.E.I.C., Engineer of Highways, Department of Public Works, Alberta.

3.55 **Discussion.**

4.15 **System of Trunk and Feeder Roads**—W. M. Stewart, A.M.E.I.C.

4.30 **Discussion.**

4.50 **Methods of Financing for Good Roads**—W. H. Greene, A.M.E.I.C., Assistant City Engineer, Moose Jaw.

5.05 **Provincial Policy of Manitoba**—A. McGillivray, A.M.E.I.C., Highway Commissioner of Manitoba.

5.15 **Provincial Policy of Alberta**—L. C. Charlesworth, M.E.I.C., Deputy Minister of Public Works.

5.25 **Provincial Policy of Saskatchewan**—H. S. Carpenter, A.M.E.I.C., Deputy Minister of Highways.

5.35 **Discussion.**

6.30 **Supper at University.**

SECOND SESSION.

8 p.m., Thursday, August 8, 1918

WATER SUPPLY AND SANITATION

8.00 P.M. **Rural Community Water Supplies**—E. L. Miles, M.E.I.C., Inspecting Engineer, Department of Irrigation.

8.15 **General Water Supply for Saskatchewan**—Frederick B. Brown, M.E.I.C.
Discussion by Manitoba Branch, W. M. Scott, M.E.I.C.

8.25 **Discussion**, Alberta Branches.

8.45 **Discussion**, Saskatchewan Branch.

8.55 **General Discussion.**

9.15 **Rural Sanitation**—W. Muir Edwards, M.E.I.C.

9.30 **General Discussion.**

THIRD SESSION.

9.30 a.m., Friday, August 9, 1918

CONCRETE

9.30 A.M. **Deterioration of Concrete**—B. Stuart McKenzie, A.M.E.I.C., Consulting Engineer, Winnipeg.

9.50 **Chemistry of Concrete**—A. G. Blackie, City Chemist, Winnipeg.

10.10 **Concrete in Alkali Soil in Saskatoon**—H. McI. Weir, M.E.I.C., Assistant City Engineer. (Supplementary Paper—Saskatchewan Branch.)

10.20 **Observations of Disintegration of Concrete in Edmonton Districts**—J. A. Kelso, Industrial Chemist, University of Alberta. (Supplementary Paper—Edmonton Branch.)

10.30 **Observations of Concrete Failures**—F. C. Field, City Chemist, Calgary. (Prepared by Special Committee.) (Supplementary Paper—Calgary Branch.)

10.40 **Methods of Proportioning Concrete, Based on Recent Experimental Work**—Duff Abrams, Professor in charge of Laboratory, Lewis Institute, Chicago.

10.55 **General Discussion.**

12.50 **Lunch at University.**
Address by Fraser S. Keith, A.M.E.I.C., Secretary, Engineering Institute of Canada.

FOURTH SESSION.

2.30 p.m., Friday, August 9, 1918

FUEL

2.30 P.M. **Fuels of Western Canada**—James White, M.E.I.C., Assistant to Chairman, Commission of Conservation, Ottawa.

2.45 **Briquetting of Lignites**—R. A. Ross, M.E.I.C., Report of Sub-Committee, Honorary Advisory Council.
Experiences with Combustion of Lignites—E. C. A. Hanson, Consulting Engineer, Winnipeg.

3.00 **Discussion by Calgary Branch**, Louis Stockett, B. L. Thomas and Wm. Pearce, M.E.I.C.

3.15 **Discussion by Edmonton Branch.**

3.30 **Discussion by Saskatchewan Branch.**

3.45 **Discussion by Manitoba Branch**, W. J. Dick, M.E.I.C. G. R. Pratt.

4.00 **General Discussion.**

4.45 **Fuel Transportation**—W. B. Lanigan, Assistant Freight Traffic Manager, C.P.R., Winnipeg, Man.

5.00 **General Discussion.**

7.00 Banquet, given by the City of Saskatoon.
Address by His Worship, the Mayor of Saskatoon, and Address by H. H. Vaughan, M.E.I.C., President, Engineering Institute of Canada, Montreal.

FIFTH SESSION.

9.30 a.m., Saturday, August 10, 1918.

PROFESSIONAL AND INSTITUTE AFFAIRS

9.30 A.M. **Legislation Governing the Status of Engineers**—F. H. Peters, M.E.I.C., Chief Engineer, Department of Irrigation, Calgary.

10.00 **Draft of Proposed Act Concerning Saskatchewan Engineers**—C. P. Richards, A.M.E.I.C.

10.15 **Suggested Legislation in Manitoba**—W. P. Brereton, M.E.I.C., City Engineer, Winnipeg, Man.

10.30 **Suggested Legislation, Alberta**—W. M. Edwards, M.E.I.C.

10.45 **Proposed co-operation between the Engineering Institute of Canada and the Canadian Mining Institute**—F. H. Peters, M.E.I.C.

10.55 **General Discussion.**

2.30 p.m., Saturday, August 10, 1918

VISITS AND EXCURSIONS

N.B.—The first forenoon (Thursday, August 8th) a number of visits are being arranged for visiting members, starting at 9.30 a.m.—Detail programme will follow.

A ladies' committee has been arranged to look after wives of members and entertainments are being arranged.

Section 44 of the By-Laws reads as follows:

"General professional Meetings of the Institute may be held once a year in each province, subject to the approval of the Council, and also at such places and times as the Council may direct, for the presentation of papers and the discussion thereof, visiting engineering works of interest and generally for professional intercourse. Such meetings shall be conducted by the Officers of the Provincial Division in the province in which the meeting is held, or if no Province Division has been established therein, by the officers of a branch in that province, to be selected by the Council. The Secretary of the Institute shall act as Secretary of the meeting and shall furnish a report of the meeting for the Transactions of the Institute."

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Methods of Financing for Good Roads*

By W. H. Greene, A.M.E.I.C.

(To be read at the Second General Professional Meeting, Saskatoon)

The primary requisite for good roads is money, and this money must be furnished by the people through some form of taxation. Just how this taxation shall be levied and apportioned so that the burden will fall equally on each citizen without causing undue hardship is the problem which confronts this Province of Saskatchewan in common with the rest of Canada and the United States. In the early days in Canada when the need for roads was first felt, the first system of finance was by statute labor, and when first promulgated was so just a solution that no one even thought of objecting to it as placing an unjust burden on them. The roads constructed served their purpose until the increase in traffic made a more expensive type necessary, one that was not merely a fair weather road for light traffic but one that could be used for heavy traffic conditions regardless of the weather. This necessitated the adoption of a new system for raising the funds required to construct them, and the example of the cities whereby the abutting property was taxed to provide the funds was followed. When adopted this was a reasonably equitable solution of the problem and was quite satisfactory as long as the property owners who paid the taxes obtained the major benefit from the improvement. During the last decade the growth of automobile traffic has changed the situation, for now the majority of the users of the highways are not abutting property owners and have, therefore, contributed nothing towards the cost of constructing or maintaining the improvement which they enjoy. It will be accepted as a general principle that the cost of public improvements should be borne by the public in proportion to the benefit received and to conform to this the majority of the methods of finance in use at present require readjusting.

This problem of finance divides itself readily into:—

(1) In what manner the funds will be made available for the actual work of construction.

(2) Who will ultimately pay for the improvement.

The funds for construction purposes can be raised in several ways, viz: by the issuing of bonds; by so arranging or curtailing the years work that its cost will fall within the annual road appropriation; or by "hoarding" the annual appropriation until a sufficient sum has been collected to enable an economically large and connected program to be undertaken and carried to completion.

Each method has its advocates but the bond issue is the most popular. The issuance of highways bonds is essentially a method of capitalizing the resources of a community for the purpose of creating improved highways. The fundamental advantage of the bond plan is the construction of a good system of roads at once, but there are secondary advantages in building roads in long stretches and in the planning of the maintenance of such roads.

*The Institute does not hold itself responsible for the opinions expressed by the authors of the papers published in its records.

The question is not merely whether a community shall incur a debt; it is also a question as to whether the maximum economic efficiency and the full development of the public wealth will be best promoted by using public credit. Highway improvement with borrowed money must be regarded as an investment. The only way, however, that a measurable income arises from the investment is by the reduction of hauling costs. From the standpoint of public economy the annual cost of hauling represents the operating expenses of the road system. The direct return upon the highway investment, then, is the reduction in operating expenses. This difference between the old hauling costs and the hauling costs over the improved roads is a real saving to the community. There are many additional economic benefits and very great social benefits which are not readily measured, such as, increased school and church attendance, improved social intercourse and usually an added stimulus to business.

The very presence of the improved road system increases the value of the rural property, and, therefore, the resources supporting the loan. It is a well established business principle that extension of credit withing safe limits is necessary for maximum results.

However, care must be exercised as to the term of the bonds and the type of construction financed in this manner. Here we can profit by the mistakes made elsewhere. In issuing bonds they should mature within the life of the improvement, thus insuring the taxpayer value for money expended, but should not mature before this time or else the present users will be paying for something which future users will enjoy at no cost except for maintenance.

Many highway officials affirm that the term of the bond need not be equal to or less than the life of the improvement provided that the cost of maintenance and renewals is paid for out of current funds and cite the case of railroads as an example. They claim that railroad ties only last about ten years, and rails have an average life of about twenty years, but that railway bonds usually have a life of fifty years—and then are refunded with other long term bonds.

The cost of highway construction may be subdivided into (a) cost of enduring features and (b) cost of perishable features. Grade, alignment, drainage structures and foundations if built to conform to a set standard can be classed as enduring structures and can safely be financed by a bond issue. The wearing surface which is the perishable feature can also be safely financed in the same way provided ample provision is made for maintenance and if adequately maintained this wearing surface will protect the enduring features in the investment, and the issue can be set to mature at a later date. Inadequate provision for maintenance is the gravest defect in the practice of building roads with borrowed capital. The bonds may be of the sinking fund, annuity or serial form; the latter being the most commonly used in the States as the capitalists favor it as making the investment

safer. With this form there is never the necessity to issue refunding bonds at the end of the term. This form also saves the community more money than with the sinking fund type as it avoids paying a higher rate of interest on the loan than the sinking fund can earn. The total cost of a loan of $100,000.00 for twenty years, interest compounded annually for the three types is as follows:—

Annual Interest on Bonds	Sinking fund compounded annually at 3%	3½%	4%	Annuity	Serial
4	$154,431	$150,722	$147,163	$147,163	$142,000
4½	164,431	160,722	157,163	153,752	147,250
5	174,431	170,722	167,163	160,485	152,500
5½	184,431	180,722	177,163	167,359	157,750
6	194,431	190,722	187,163	174,369	163,000

Consider now by what form of levy or taxation the requisite funds are to be obtained. The several systems of finance as practiced on this continent may be summarized as follows:—

No. 1. Province pays the entire cost.

No. 2. Total cost assessed against the property abutting on and improved by the highway.

No. 3. Province pays a portion of the cost and the balance assessed against the rural municipality as a whole or against the property situate in an "improvement district" bordering on the highway.

No. 4. Province pays a portion, each urban municipality pays a portion of the cost of those roads within a certain radius described about the urban centre, and the balance assessed against the rural municipality benefited.

No. 5. Federal aid for a portion of the cost and balance distributed as under Method No. 4.

No. 6. By a wheel tax collected either by the licensing of all vehicles or by toll stations.

Methods 1 and 2 are merely mentioned but should not be favorably considered as everyone will doubtless agree that both are unfair. illogical and uneconomic, and moreover have a retarding effect on roadway improvement. The remaining four methods are not in the experimental stage but have all been tried out successfully which proves conclusively that the problem of finance is a local one for each Province to handle as the equity of each system depends on the relation between local and national finances, the climatic and soil conditions, density of urban and rural population, the manner in which the population is distributed and the nature of their occupation.

The Province of Quebec uses Method No. 3, and is conceded to have a fine system of roads, while Method No. 4 is used in Ontario where the public is well pleased over the results obtained. With further reference to the procedure adopted under Method No. 4, it is now known that the expenditure of city taxes on country roads is a sound principle. The improvement of market roads results in improved business within the city as most cities are dependent upon the surrounding country for their prosperity and development. Since the introduction of the motor car, the country highways have been used to an increasing extent by city residents and it is surely sound logic that they should bear a proportionate cost of the improvement. The placing of the financial burden entirely on the farmer has been practiced too long and is the cause of the slow progress made in improved highways. Europe discarded this practice long ago and portions of the United States more recently. Methods 5 and 6 are in use in the United States where the Good Roads movement is progressing very favorably. The majority of the states use Method 5, while as for No. 6, a system of toll gates is practiced in Virginia, and with such success that the resulting fund not only maintains all the roads, but provides the money for extensions. Also, Illinois proposes to expend sixty million dollars on roads and pay for and maintain them from automobile license fees. Placing the burden of the cost on motor vehicle owners seems at first thought an unfair method, and one burdensome on the motor users. Unfair it admittedly is, and yet every organized body of motorists and every organization of the motor industry in the state is energetically working to secure the passing of the law. The measure increasing the registration fees to a point necessary to finance the whole program was made law not against but with the concerted efforts of the motorists. However, this is distinctly class legislation and while not so unfair when applied to Illinois with its vast number of motorists would decidedly be both unfair and burdensome if attempted in Saskatchewan, but if horse-drawn vehicles were proportionately taxed, then a more logical method of finance would be attained. This wheel tax would not necessarily be paid wholly by those upon whom it was imposed. but would naturally be distributed by those individuals among the persons directly or indirectly benefiting from the carriage of goods over the roads.

Whether or not this wheel tax system could be extended to meet the requirements of this province or whether it would prove uneconomic by curtailing desirable development through the inadequacy of the funds provided is an open question and one requiring careful study.

The problem is a vast one and with the total mileage of roads in Saskatchewan requiring improvements may, at first, appear hopelessly beyond our resources, but we must realize that good roads are the basis of the entire transportation system of the country, and as such are not a non-essential. Mr. W. F. Tye of Montreal stated not long ago that the non-success of the Canadian Northern and Grand Trunk Pacific railways was due to the lack of a well-constructed highway system to feed their main and branch lines. The prejudice which existed not so long ago against good roads is fast disappearing and they are now recognized as an economical necessity if this country is to progress as it should. The expenditure must and will be large, but if financed in a proper and logical manner will not be burdensome on the community either individually or collectively. As stated by Mr. W. A. McLean, C.E., Deputy Minister of

Highways for Ontario, at the Good Roads Congress held in May of this year, "Yet roads will not be a financial burden. Heavy in a sense, yes, but in carrying on this war we have discovered that what seems a heavy financial undertaking is purely an attitude of mind. If we want good roads, we can pay for them. The financial cost that we have undertaken through this war would have previously seemed impossible to the most efficient of our financiers. Today we see how it was accomplished. Today, the road problem payment seems heavy. When it is paid for, we will discover that we only had to do a day's work at a time and a year's work was finally accomplished, and we paid for it through our daily earnings at the end of the year, and it was not such a heavy burden after all."

A discussion on highway finance would not be complete without considering the very essential subject of maintenance. This is a question partly of management and partly of finance. The only too common tendency is to neglect the maintenance of roads which have in many cases been built at great expense. Unless an adequate fund is provided and utilized for the upkeep of the system then the money used in construction has been wasted. A good plan, and one becoming popular in the United States, provides that a fund must be provided for in the taxes for use in maintaining roads constructed by means of bond issues, said fund to be kept separate from all other county funds and used only for maintenance. The Federal Aid Road Act of the United States provides that unless roads constructed under the provisions of the Act are adequately maintained then approval of further road programs for the section may be witheld until such time as the roads have been properly repaired. There is a growing tendency to tax, by licensing or registration, all vehicles whether motor or horse-drawn that use the roads, and it is desirable that the funds raised in this manner should be utilized either wholly or in part for maintenance, not as a punishment for the use of the roads, but because there will be a constant proportion between the amount of wear and tear and the amount of money raised. This might be carried further and a tax imposed on gasoline for then the occasional and the constant user would each pay in absolute ratio to the use made or mileage covered. A tax of this description is levied in England, but the fund into which it goes is not utilized for maintenance but for construction.

Financing Road Work in Saskatchewan*

By H. S. Carpenter, A.M.E.I.C.

(To be read at the Second General Professional Meeting, Saskatoon)

All moneys used for the construction and maintenance of rural highways in the Province of Saskatchewan are provided and administered either by the Department of Highways of the Provincial Government, or by the councils of the rural municipalities.

The moneys spent by the Department of Highways are provided for in the annual estimates under two main heads: (a) money provided from income account, and (b) money provided from capital account.

To income account is charged all expenditures for the construction, maintenance and operation of provincial ferries, construction and repair of timber bridges, maintenance and repair of roads, and maintenance and repair of permanent bridges.

To capital account is charged the construction of roads, and the construction of permanent steel and concrete bridges.

From the time of the formation of the province in 1905 to 1912 highway expenditures were controlled by the Department of Public Works. During this period all road construction was charged to income account, and permanent bridges only were charged to capital account.

In 1912 the government decided that the time had arrived when a more extensive program of highway improvement should be entered upon, and to this end adopted a policy of borrowing money to carry on road construction work as a capital expenditure. A Board of Highway Commissioners was formed to take charge of the administration of this enlarged program.

For the years 1906 to 1911 inclusive the annual expenditure of the Department of Public Works on roads, bridges and ferries averaged about $784,000. The Board of Highway Commissioners spent in each of the years 1912, 1913 and 1914 on the same services about $2,000,000.

Since the outbreak of the war it was thought advisable to curtail expenditures on highway improvement and the annual expenditures for 1915, 1916, 1917 and the current year average only about $700,000.

Main Road System.

The Board of Highway Commissioners formulated a policy of, as far as possible, concentrating the expenditures under its control on the improvement of the main market roads of the province.

There are in the settled portions of the province about 175,000 miles of road allowances. The improvement of this large mileage would be a tremendous task for the people of this province. Very much of this mileage is however on roads which are purely local roads which will carry only very light traffic, and fortunately in the open prairie portions of the province many of the roads will in their natural state serve for many years to come to accommodate the small amount of traffic which will pass over them.

It may be roughly estimated that 20% of the above mileage will be included in a main road system or about 35,000 miles, and probably these 35,000 miles will carry about 80% of the traffic. The improvement of this 35,000 miles of road represents a big program of road improvement work, but one which the rural municipalities with liberal assistance from the government may hope to accomplish within a reasonable time. When we have succeeded in providing well graded earth roads together with necessary culverts and bridges of a perman-

*The Institute does not hold itself responsible for the opinions expressed by the authors of the papers published in its records.

ent nature to accommodate 80% of the traffic we will have advanced a long way towards solving the problem of good roads for the province.

The policy of limiting government expenditures to the improvement of main roads embodied in a main road system makes possible a well defined program of work, a steady adherence to which will insure that every dollar spent will bring us nearer our goal.

The Board of Highway Commissioners, in accordance with its main road policy, established on paper a system of main roads for the province. This was drawn up after consultation with the councils of each rural municipality, from information on the files of the Department of Public Works and from information gathered in the field by officials of the Board.

Thus a start was made towards the development of a main road system, and while this scheme was drawn up with the idea of, as far as possible establishing this permanently, conditions in a new and growing province such as Saskatchewan where the opening up of new lines of railways is followed by the growing up of new market centres, are such that modifications have to be permitted to meet changed conditions, so the original main road scheme has been modified and extended from time to time as circumstances required.

Administration of Highway Expenditures.

In 1917 the Department of Highways was established to carry on the administration of all highway work which had previously been carried on by the Board of Highway Commissioners.

The selection of the locations upon which improvements shall be made each year rests with the department and is arrived at after consultation with the councils of the rural municipalities, and on the recommendations of the divisional superintendents. These latter are officers of the department who have charge of the immediate supervision of the work in each of the eight divisions into which the province is divided.

During the years 1912 to 1914 when under the Board of Highways Commissioners the government was spending a large sum each year on road and bridge construction, the work was carried on either by government road and bridge crews or by means of grants to rural municipalities. The government crews were organized, controlled and paid by the Board. There was sufficient work at that time to keep these crews employed for the whole summer season. These crews under the same foremen, with very much the same personnel, and even the same horses were employed year after year and generally became very efficient in their work.

Grants were given to rural municipalities for road construction work on what was called the dollar for dollar basis. The Board entered into an agreement with the rural municipalities to make a grant for the improvement of certain main roads selected by the municipality and approved by the Board, the municipality agreeing to contribute an equal amount from its own funds. The work was carried on by crews in the employ of the municipality and the Board paid over to the municipality one half the cost of the work, on the certificate of an inspector of the Board that the work had been done in accordance with the specifications and agreement.

Since the outbreak of the war the expenditures made by the government have been on such a reduced scale that it was impossible to give the government road crews sufficient work to maintain the organization. It was necessary also to discontinue the system of grants to municipalities. The Department of Highways now carries on the greater part of its road construction work by authorizing an expenditure on certain main roads approved by the department. The department being satisfied the rural municipality has the organization and equipment to satisfactorily carry on the work, enters into a contract with the municipality whereby the municipality performs the work with its own crew and the department pays the amount authorized to the municipality on the work being completed and on the certificate of the department's inspector that the work has been carried on in accordance with the specifications.

The arrangement referred to above applies only to road construction. In the case of bridge construction very few of our municipalities have the equipment or the desire to handle the construction of the larger bridges. Practically all bridges of a span of 20 feet or over required throughout the province are built and paid for by the government. The bridges constructed by the government are broadly of two kinds; timber bridges on pile abutments and pile bents, and steel bridges on concrete or pile abutments. The timber bridges are built by bridge crews employed by the Department of Highways and as stated before are paid for out of income account The steel bridges on concrete abutments, also the reinforced concrete arch bridges, several of which have recently been built, are all let by contract and paid for out of capital account. All the timber for the timber bridges, and the steel and cement for the larger bridges are purchased by the department direct from the manufacturers.

Saskatchewan is an earth road province and it will no doubt be many years before outside of the cities and towns any very considerable mileage of metalled road surfaces will be constructed. For this reason the question of maintenance has become one of the most important problems we have to deal with. To induce rural municipalities to give more attention to this very important matter the government is now distributing to municipalities in the way of direct grants a large part of the money collected as fees for auto licenses. This is given to the municipalities on condition that it shall be used for the maintenance only of main roads leading to market town. The amounts given to each municipality in this way are not large, but it is hoped that with the expenditure of this money on maintenance work the municipal officials will be brought to see the wisdom of devoting more money for this purpose than has been done in the past, and that the amounts contributed by the government for this purpose will be supplemented to a considerable extent by the municipalities.

Rural Municipalities.

The rural municipalities in the province up to and including the year 1914 were spending in the aggregate on road improvement work an amount about equal to that spent by the government, and since the outbreak of the war have not reduced their expenditures to the same extent as has the government.

In rural municipalities the money for road and bridge construction is obtained generally from current taxes, though many municipalities have raised money for this purpose by the sale of debentures. This latter method was resorted to to a considerable extent in the years 1912 and 1913 to provide the money contributed by the municipalities as their share under the dollar for dollar agreement with the Board of Highway Commissioners.

No special tax is imposed in rural municipalities for road improvement work or other public works. The council sets aside from the revenues of the municipality as much as it determines can be allocated for this purpose. The money is authorized for the improvement of such roads as the council selects. The Rural Municipality Act however provides that one half the total amount estimated to be expended for general municipal purposes within the year (exclusive of the proceeds of debentures) shall be distributed among the divisions in proportion to the assessed value of the taxable property in each division, unless the council by unanimous vote decide that this amount may be reduced to any amount not less than one quarter of the total estimate. Moneys raised for road or bridge construction by the sale of debentures must of course be spent to carry on the work specified in the by-law.

The Department of Highways exercises no authority or control over the expenditures made by rural councils, or the selection of roads upon which the councils will spend their money. Both the department and the rural councils are or should be working towards the same end. It is the policy of the department to plan its improvements as far as possible in harmony with the plans of the municipality and many of the authorizations for expenditures by the department in a municipality are made pursuant to an arrangement covering expenditures of municipal funds by the council.

Rural Community Water Supplies*

By E. L. Miles, M.E.I.C.

(To be read at the Second General Professional Meeting, Saskatoon)

I am very much pleased at this particular time to give an account of a few of my observations while acting as an inspector of water supplies in the Province of Saskatchewan, for the Irrigation Branch of the Department of the Interior, during the field seasons of 1916 and 1917 and the part of 1918 just past. I am pleased for two particular reasons. First, because I wish to help in some way to make this gathering successful and encouraging, and second, because I feel that all engineers should tell their experiences which are always helpful to other engineers, and are always interesting, if for no other reason than that they are engineering experiences.

My chosen subject of Rural Community Water Supplies is in itself a very wide subject, inasmuch as it is only in its infancy of development, and to-day there are many destitute farmers, who cannot risk the keeping of a cow on the place on account of the shortage of water, Nothing in my travels caused more wonderment in my mind, than to drive into a farm yard in quest of a refreshing drink of water, on a hot day, and to find that the only available drink was warm rain water, or stale lemonade, backed up with the excuse that the children had not yet gone to town for the water. I wondered what kind of people they were, who could endure a life of this kind, especially as there were other lands available in this vast Canadian West where such conditions do not prevail. The growing of wheat is the solution, and strange to say, this extremely dry belt holds one of the best records for wheat production.

Owing to the fact that my inspections have been confined to the province of Saskatchewan, I will of necessity confine my remarks to it, and ask you to picture the map in your mind's eye. Generally speaking, it is known as wet in the north and dry in the south, but in reality it is wet in the north-east half and dry in the south-west half, the division being the line of tree or brush growth. This line commences in the north-west at about Lloydminster, and follows down the North Saskatchewan river to a point about half way between Saskatoon and Prince Albert, thence in a south-easterly direction to the South-east corner of the province. The growth in the wet area starts with small poplar and willow, and gradually grows into the larger type as one proceeds north, until township 55 is reached where timber of spruce and hemlock is obtained fit for saw-mill purposes. Over this territory, surface water as well as ground water is found in abundance and nearly all the streams are perennial. Drainage schemes are numerous in the flatter parts, which indicates considerable "spoil land".

The south-western part of the province known as the dry part is mostly open prairie, and surface water is very scarce in the summer and fall of the year. The old creek beds and sloughs become dry so that underground water has to be found, or else surface water impounded and held for dry seasons. Ground water is not, as a general rule, hard to find, although there are isolated districts which are most difficult and expensive to prospect. In these districts the average farmer is not financially able to procure it by deep well drilling, and I know of cases where drilling up to 1,500 feet has failed to locate water. In these districts the government has assisted the farmers by creating reservoirs of various types, for the purpose of holding the spring runoff, as well as any precipitation which might occur during the summer. In the early days, stock watering reserves were located along the principal rivers for the benefit of the ranchers. A great many of these, however, have been cancelled, and the balance are now on the slate for inspection, to determine their value. Those in Saskatchewan were located principally along the South Saskatchewan river and in the Cypress hills.

Generally speaking, small towns and villages are in a primitive state as regards their water supplies. In some cases water is hauled from neighboring springs and sold

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to the residents in pails or by the barrel. This, however, is due to the lack of funds which might better the conditions. In other cases the town pump is in evidence at the principal street corner. The larger towns have their own systems, which is a subject in itself.

The Act Respecting Irrigation.

This act, composed and operated by the Dominion Government, through the Department of the Interior, for the benefit of the two prairie provinces (Saskatchewan and Alberta) as regards the administration of water rights, is, probably the most argumentative law known when directly applied to the farm. Besides the regulations it contains for the irrigation of land and the purchase thereof, it also administers and regulates the use of all water which flows on the land, whether it be through a city or the smallest farm. In proof of this I will recite the following rulings as contained in the act,—

> "The property in and the right to the use of all the water at any time in any river, stream, watercourse, lake, spring, creek, ravine, canon, lagoon, swamp, marsh or other body of water shall, for the purpose of this Act, be deemed to be vested in the Crown, etc." Also:
>
> "No person shall divert or use any water from any river, stream, watercourse, lake, creek, spring, ravine, canon, lagoon, swamp, marsh, or other body of water, otherwise than under the provisions of this Act, etc."

You will note that these rulings contain the words watercourse, spring, ravine, marsh, and all other bodies of water, and it is for this reason that the average farmer becomes indignant when he finds that his right to the surface water on his own farm is limited, He immediately proceeds to tell the inspector how he wandered back onto the desert prairie in the early days to locate a homestead and spent many days in search of water for farming purposes, passing up most desirable land because the prospects for obtaining or storing good water were poor. Now he finds that the man who came later and took up the more desirable land has almost an equal right to his water supply, or can through this Act, obtain such a right. This fact is particularly annoying if the farmer has through his so-called wisdom succeeded in locating a spring. This spring, if it happens to be the only one in the neighborhood, is looked upon by this lucky farmer as a divine right, and by reason of it, he invites his desirable neighbors to partake of it. But there is in all communities, an undesirable neighbor, (from Bill Smith's point of view) and he is barred the privileges which the other neighbors enjoy. He is, therefore, often compelled to seek the assistance of the whole community through the Council of the Municipality, in order that he too might enjoy an equal right with his neighbors. The municipality then find that they either have to adjust the water proposition on Bill Smith's farm or else ask John Jones to leave the country. But the government has spent a lot of money in getting John Jones to come to the country and take up land, and as he is a good farmer and a desirable citizen and despite this personal quarrel with Bill Smith, they want him to stay. So, through the working of the Act, the eternal gratitude business attached to Bill Smith's spring is removed.

The Act, however, where water courses are concerned, has a far wider effect than the mere administration of water for the benefit of any particular community. These water courses are unit parts of large drainage basins and go to make up the larger streams and rivers of the country, on which certain large industrial, municipal and other rights have been granted, and these, of course, have to be protected. The department should, therefore, know all the details of every scheme located in the drainage basin, more particularly the quantity of water held in storage. No farmer, on account of his riches, should be allowed to create a lake for the purpose of canoeing or other pleasures, if in so doing he holds up the natural runoff to the detriment of others. This, however, is not a serious question at the present time, but the time will come as the country becomes more thickly settled, and dry seasons occur, when lawsuits will be numerous and costly.

Through the information furnished by the hydrometric service covering the larger streams, and the inspections and reports on the various schemes in the drainage basins, water administration can be handled in a form of book keeping, and in this way the department has an intelligent check on the water supply of the territory, over which the Act has jurisdiction.

The Spring.

The spring is, of course, the most sought after source of water supply in these dry districts, being perennial by nature, and because of the purity of the supply. There is, however, a wide diversity of opinion as to the limits of the jurisdiction of the Irrigation Act in comparison with the development which might bring the scheme under the heading of a "well".

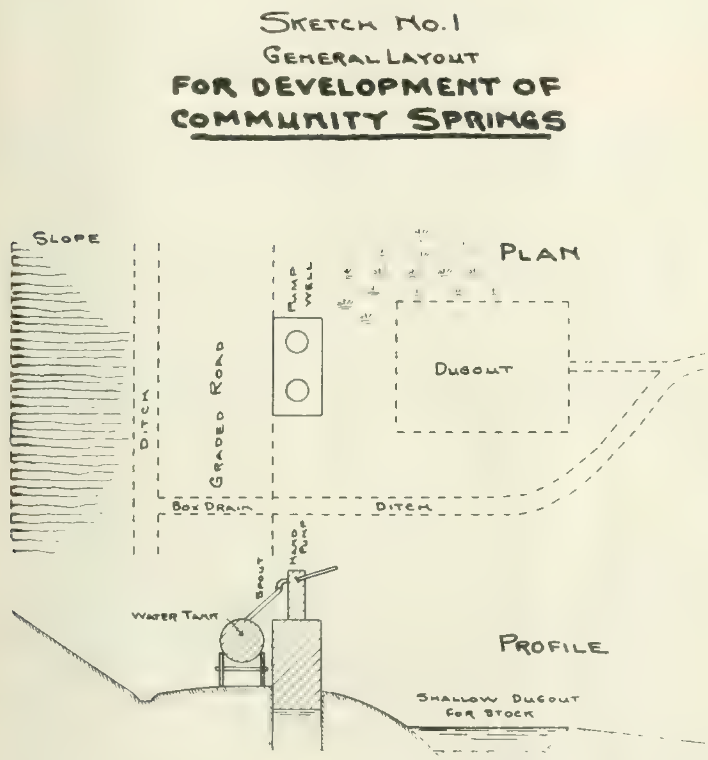
The difference in my opinion is simply this; where a man of his own ingenuity finds water by digging into the surface soil, the water found by him is his own property, to do with as he may see fit. If, however, he finds a surface indication of water, if only in the form of a miniature marsh, and by developing this indication by any means whatsoever, he produces a constant supply which of itself remains constantly at the surface or near it, this supply is a spring water supply and the right to it is vested in the Crown. The Crown, of course, reserves to the land owner the first rights to the supply, and the balance, if any, is licensed to the applicant.

The development of springs depends largely upon conditions, but for rural communities the general rules are as follows: first, to establish a graded road to and from the site, next to construct a box to which a pumping appliance can be installed, and next, the excavation of a reservoir for the use of stock. Sketch No. 1 attached shows the general layout for development of community springs.

Reservoirs.

This is, indeed, the most interesting type of water supply development from an engineering standpoint, inasmuch as the construction of the dam requires considerable engineering judgment, especially in view of the fact that stone and concrete are not always available in these dry districts. The best and most efficient reservoirs

which have come under my observation is the combined reservoir and dugout in narrow coulees, say up to a depth of about 50 feet, where the supply is more readily replenished from the larger drainage basin or watershed and the reservoir is protected from hot winds, etc. They are less susceptible to flooding, and depth of water is obtained by means of a dugout. The dam is usually low, and the spillway problem is therefore more readily solved. The spillway capacity is invariably under estimated, that is, they are built for normal conditions rather than extreme flood conditions. The extreme floods occur about once every seven years and when they do occur, it is common to find about 75% of the dams washed out. I am a strong advocate of placing the spillway always at the side of the dam in the natural ground, rather than in the centre, even though the spillway be constructed on piles, as I sometimes find them.



Community dams are usually built on road allowances, the top being used as road-ways. This has been disputed as "good practice" but I am personally in favor of it, especially on account of having the water convenient to the highway, and the fact that the work is not duplicated. The inconvenience to travel by reason of washouts occurs in any case, and we are living in hopes that the day will soon come when these yearly washouts will be stopped by better engineering construction, even though it means greater initial cost in the first place.

A brief form of instructions for the construction of a dam aside from the general specifications as to dimensions and slopes might be cited as follows:

On commencing the construction of a dam it is important that the site be entirely stripped of all sod and vegetable matter, and that same be removed to a convenient point, to be used after to sod down the top and lower slope, on completion of the work. The ground thus stripped should have furrows ploughed every four or five feet, at right angles to the coulee, in order to give a rough surface to the ground to resist seepage. The puddled wall trench should then be dug to a depth well below the top soil or loam, into an impervious strata and the trench re back-filled with a selected clay, and well puddled with water. When this trench is filled the main portion of the dam should be commenced, and the material used should be a suitable clay, free of vegetable matter and stones. The borrow pits which should be located on each side of the dam on the upper side, should therefore, be stripped of both sod and top soil. The material should be spread on in thin layers, and well consolidated by tramping, but special runways should be avoided. It is also important that the sides be carried up considerably faster than the centre, and that the centre immediately over the puddle wall be continued up into the embankment for at least three and one half (3½) feet.

On completion of the earthwork, cobble stone rip-rap should be placed on the entire upper slope, to assist the clay to maintain its slope, as well as to prevent wave wash from wind. If cobble stones are not available, lumber is sometimes used for this purpose, in the form of an ordinary board fence constructed in the slope. Shrubs are often planted from the water line to the top on the upper and on the entire lower slope. The balance of the earth work should then be seeded down, after the available sods from stripping have been placed.

The spillway must take care of the entire runoff after the dam has been filled, and in no case is any water to be permitted to go over the top of the dam. Providing the owner can afford this expense, the spillway should be paved with concrete or hand-placed rip rap for a distance of about twenty (20) feet on each side of the centre line of the dam, and the paved portion should be level so that the current in it will be reduced as much as possible. After leaving this portion, care should be taken to ditch the water away from the embankment, and the ditch should be well rip rapped to prevent erosion.

After completion, the embankment should be inspected from time to time, and any defects, such as settlements, rain wash, wear from stock tramping, or damage from burrowing animals, should be repaired. Special attention should be paid to the spillway after the spring run-off to see that the rip-rapping is not undermined or washed out.

Reservoirs of the type outlined above with the spillways at or above the high water line are of course difficult to clean, but they are built nowadays in this manner as a matter of economy. Sluice pipes equipped with valves, or concrete spillways equipped with stop logs or gates would, of course, make them more complete.

In some private schemes I have found some very unique forms of construction, especially where people from foreign lands have constructed the dams. One form is to build a rustic fence of poles, interlaced in a

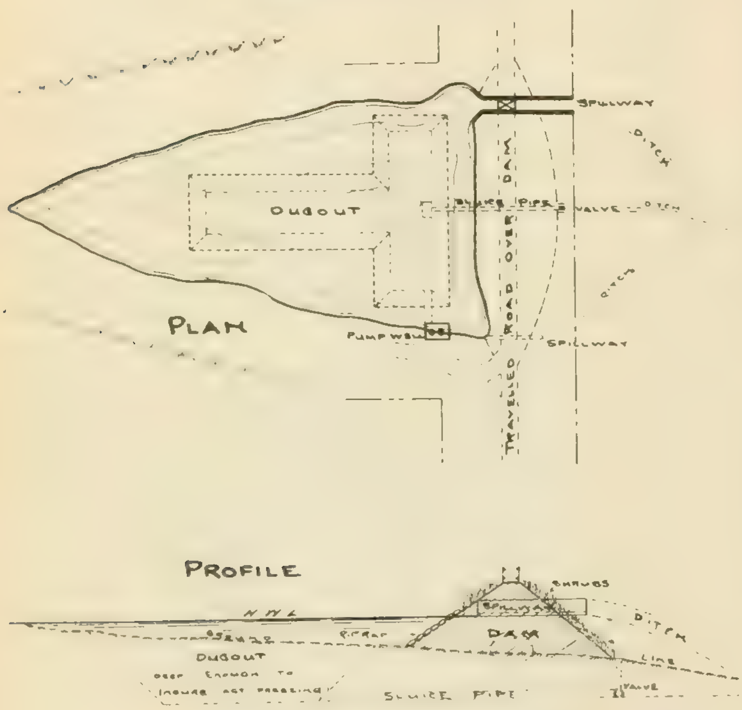
strong manner, and then covered with the earthwork, having the fence sticking up through the upper slope at the high water line. Sometimes this fence is seen on the lower slope, and where this type is used the dams are usually intact, while others nearby have been washed out of existence.

Sketch No. 2 shows a general layout for community reservoirs in coulees.

Dugouts.

The most peculiar form of reservoir is the dugout located on the flat open prairie in heavy gumbo soil. These dugouts are generally about two hundred feet long by fifty feet wide and from ten to fifteen feet deep,

SKETCH NO. 2
GENERAL LAYOUT
FOR COMMUNITY RESERVOIRS
IN COULEES



with sloping sides, holding about 700,000 gallons of water. They are equipped with pumping appliances for the taking of water, and fenced with high board fences to protect them from pollution. They are rather popular, as the water does not deteriorate very rapidly, on account of the depth and the minimum surface area. Plant life is also dept down, and the cost of construction and maintenance is comparatively low. Dugouts are sometimes located in dry slough beds, on account of the impervious soil and because of the natural location for replenishment. But this is not a desirable location, because of the quality of water in them. It is usually high in color from decayed vegetation, and therefore more infested with insects.

A dugout of this kind will serve an area of about nine square miles, based on the following estimate. The average farm in the grain district is about one-half section or 320 acres of land, each farmer supporting about six persons, ten horses, ten cows, and ten hogs, which will consume about 600 gallons of water per diem, or a little less. So that the estimated water supply for each township would be about 43,000 gallons per day, at all times, or about 72,000 gallons per day in the threshing season, considering that only about one-quarter of the farmers of the township are actually threshing at the same time. The standard dugout of about 700,000 gallons capacity, with four to each township, in addition to the usual private means of water supply, will give a full 40 days supply, which is generally the length of the brisk threshing season for which these 40 days are considered.

Sketch No. 3 shows the general layout for community dugouts on flat open prairie.

Losses from Open Reservoirs.

Just here I might add a few remarks concerning the estimated water losses from open reservoirs. There are two noticeable agents of losses. First, evaporation, and second percolation. The first means evaporation into the air due to atmospheric conditions, and degree of shade from the midway sun and hot winds. The second means that portion taken up by seepage into the ground, plus that portion taken up by plant life. Generally speaking, open reservoirs lose about forty (40) inches per year from these agents, depending largely on the protection as well as the depth. It is advisable to locate the reservoir with these points in view, viz., a minimum surface area with a maximum depth.

Lethbridge Conference, June 22nd, 1917.

To those who had the pleasure of attending the conference called by the Lethbridge Board of Trade on June 22nd, 1917, and had the pleasure of hearing the discussion on "More and Better Water for Our Farms" will probably find this paper merely a further discussion on the subject, devoid of any radical recommendations which might be considered new, however, as stated before it was my intention to stick to personal observations as far as possible, and I trust that you have been able to find a certain amount of information in them.

For the benefit of those who have not even had the pleasure of reading the very excellent report of this conference, I might quote a few of the conclusions arrived at, with perhaps an odd personal remark.

1. "That the drill test is the only true test of underground water supply."

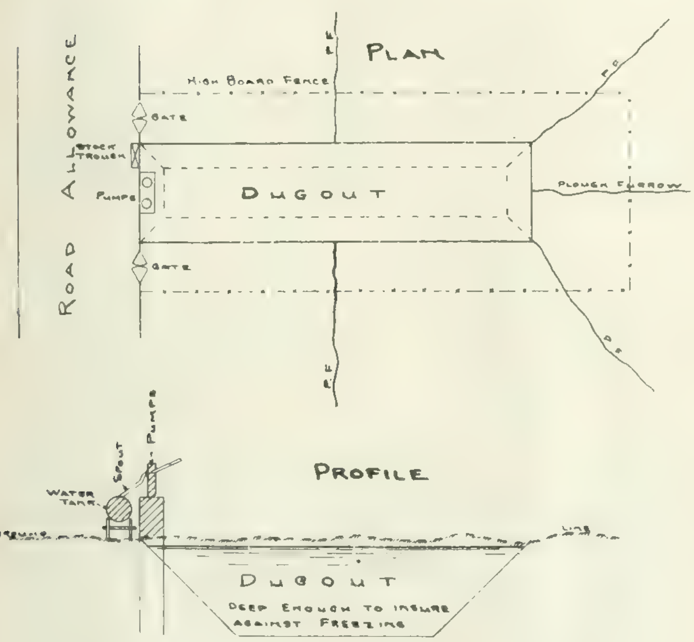
Just here I might say that I am very sorry that I have been unable to find anybody who was willing to prepare a paper on "Deep Well Drilling". Few engineers have had very much practical experience in drilling, and therefore it is most difficult to prepare specifications which do not conflict with the practice, and which will cover any contingencies which might occur.

2. "That the Governments should undertake these tests for the benefit of the farmer."

The Dominion Government has already explored a part of the artesian water area in Southern Alberta, with most excellent results. I had the pleasure of visiting one of their wells near Pakowki Lake, where a discharge of about 30,000 gallons per diem is obtained of most excellent fresh water. This well was about 650 feet deep, having been drilled with a 3 inch rotary drill, and only cased at the top and bottom. The top is efficiently capped, and the bottom protected from caving by means of a packer.

> 3. "That efforts should be concentrated on making the drilling of these test holes as inexpensive as possible and the best way to do this is to use the rotary method of drilling."

SKETCH NO. 3
GENERAL LAYOUT
FOR COMMUNITY DUGOUTS
ON FLAT OPEN PRAIRIE



This, I suppose covers the test wells for artesian water.

> 4. "That no water witch or water machine has yet been developed which is in any degree efficient or to be relied upon."

This is rather contrary to the experience of Sapper Stephen Kelley, known as an expert diviner in Australia, having located many shallow sources of water supply for the sheep herders of his country. It appears that the water supply for the Gallipoli campaign was brought to the troops from outside sources by tank steamers. This being very difficult on account of the gun fire from the Turks, the troops were often short of water. Sapper Kelley being a sufferer from wounds as well as from thirst, got up from his bed, straightened out the flange of a Turkish shell which he used as a divining rod, and located a prospect, which on digging to a depth of six feet was found to yield a flow of 2,000 gallons of water per hour. The shortage was at once obviated and the trench manned with a rejuvenated army. The extreme shallow depth and Mr. Kelley's keen observation had undoubtedly much to do with this success.

It does not seem reasonable, however, that scientific electrical water finders should be entirely failures.

> 5. "That the provincial government road department should aid in the construction of surface reservoirs in places along the road allowances where roads must be built across coulees."

The Provincial Government of Saskatchewan has carried out this policy in a very effective and considerate manner.

> 6. "That a law should be passed forcing drillers to keep a log of every well and send it to the government."

> 7. "That a law should be passed making it unlawful to allow any artesian wells to flow unchecked, as the conservation of underground waters is important, being in fact, the most important of all our natural resources."

This law should be passed and understood before the wells are drilled because once the water starts to come to the surface outside of the casing it is almost impossible to stop it. I know of one flowing well near Nakomis, Sask., where this well is causing considerable damage to land and roads, but it cannot be stopped as the drill did not enter rock, and more water is coming up around the casing than through it. The Government well at Pakowki lake also has a leak around the casing and it is my opinion that if a valve is placed on the pipe, this condition will simply grow worse. These leaks can, however, be cut off, as solid rock was encountered at sixty-five (65) feet.

> 8. "That the laws governing the polution of streams should be enforced in connection with settlers living along irrigation canals."

The question of "Rural Sanitation" will be fully dealt with by Mr. Muir Edwards, Professor of Civil and Municipal Engineering, University of Alberta, Edmonton, and I will, therefore, not make any comment on this subject.

> 9. "The farmers should take greater pains to conserve the rain water from roofs; waste in this direction being one of the worst forms of waste in Western Canada."

I have found many well constructed rain water cisterns in the dry belts. They are often equipped with hand pumps at the kitchen sink, for the convenience of the household.

> 10. "That the farmers should endeavor to conserve surface water for stock by building reservoirs and dams in coulees."

In addition to the public schemes along the highways almost 50% of the farmers have private reservoirs of some kind of their own for the purpose of watering stock,

but they are generally nothing better than duck ponds, and being close to buildings and uncared for, they are often very rank. Occasionally I find the dam built of nothing better than manure.

These seem to be the main and essential points of the Lethbridge convention, but I would certainly recommend that those who have not read their report should do so at the first opportunity.

Conclusion.

It is my opinion that the problem of water supply is going to become more acute as the country becomes more settled, and the question is going to require more engineering aid than it has in the past, if the best results are to be obtained.

Signs of insufficient investigations are noticeable at times, such as dry reservoirs, indicating unsuitable soil conditions, and let us hope that the practice of installing incomplete schemes, because of lack of money, or other excuses, will be stopped, if for no other reason than that these dilapidated schemes are bad examples in the country. It is false economy to half build a big scheme. Better to build two small schemes well. This is another case where the Public Utilities Commission of the provinces, could increase their efficiency by making better use of the engineering profession.

Deterioration of Concrete *

By B. Stuart McKenzie, A.M.E.I.C.

To be read at the Second General Professional Meeting, Saskatoon.

The following paper is presented to the Saskatoon meeting for the information of the members and in the hope that some way may be found to make the records of fact perfectly complete, and that a full and satisfactoy explanation may be reached to account for the conditions of the concrete work herein described.—Editor.

In presenting this subject, under the general title given above, for discussion, it is proposed to eliminate theory as much as possible, and to cite (literally) concrete examples of deterioration under various conditions, together with the results of various laboratory experiments which have been carried on during the last year or two. These experiments have been conducted by the City Analyst of Winnipeg, Mr. Blackie, and he has been very materially assisted by Mr. Thompson of the Greater Winnipeg Water District, who has made some very interesting density tests. Examples which will be given are taken from experience in the Province of Manitoba, and mainly in the City of Winnipeg. These have all come under the observation of the writer, or have been reported to him from reliable sources.

As this subject deals with underground conditions, the examples naturally divide themselves into two main classes:—

(1) Foundations for Buildings or Bridges.

(2) Pipes for Sewers, Drains or Water Supply.

These will be discussed in the above order and a few typical examples given.

I. FOUNDATIONS:

(1) The first case which came under the writer's observation occurred in the column footings of a 7-story office building, in Winnipeg. The footings were of the usual square stepped design. Owing to proposed increase in loading it was considered necessary to put caissons to rock under the existing footings, and in the course of excavation for this work some rather extraordinary conditions were revealed. The first discovery was made by one of the workmen who was engaged in placing a strut between two adjacent footings. To his astonishment the concrete of one of the footings appeared to be practically a slime. The mass was so soft, indeed, that he could without difficulty, plunge his hand into same and squeeze the material through his fingers. The matter was reported to the writer, who was associated on the work, and an examination of the material was made. The concrete had the appearance of lime mortar, being quite white and of a slimy consistency. There was quite a strong smell of sewage, and the inference, at first, was that there had been a chemical action by sewage from a broken drain in the vicinity, but this was not confirmed by further investigation. (This matter will be again referred to in the discussion of Pipes). Other examples were soon discovered in other footings as the work proceeded, and conditions were of such a nature that the architect in charge of the work decided to remove the old footings altogether and to build the caissons up to the base plates of the columns. In one extreme case a mass of concrete fell away from the corner of a footing and was so soft that it was possible to swing the head of a sledge hammer sideways through the mass. The disintegrated concrete on being allowed to dry becomes fairly hard with a white powdery surface. In the course of removing the old footings it was found that patches of this soft concrete occurred in what appeared to be otherwise quite sound masonry, thus indicating that a gradual rotting process was going on, which now appears to be most probably due to some chemical action by the ground water which had gained access to the footings. Wherever the condition was found it was observed that the concrete was very damp and porous, and the latter condition may explain the action to a certain extent. A specimen of the concrete has been brought up for examination, and this clearly shows the action which was going on. Chemical experiments are now under way to determine, if possible, the cause of this action, and these will be referred to later on.

(2) The second example was discovered when exposing the surface of caissons which had been lying in the clay for over 14 years. These were under one of the 10-story office buildings in Winnipeg. It was found necessary, on account of settlement in the building, to excavate under these old caissons and continue same

*The Institute does not hold itself responsible for the opinions expressed by the authors of the papers published in its records.

to rock. They were generally lying at a depth of about 35 ft. below bround level, and in practically every case (21 in number) water in considerable volume was found lying around the caisson and concentrated at the bottom. This water had come from under the basement floor and seeped down along the surface of the caisson. The first caisson exposed had an unusually rough surface, having the appearance of a pile of broken stone. There was a certain bond between the stones but the concrete was full of large voids. If mortar had ever existed in these spaces it had entirely disappeared. The appearance of this caisson is shown in slide. It was noted that in the spaces mentioned above a deposit of a brown jelly was often found. It was thought at first that this might be gelatinous silica, left as a residue from some chemical action, but this was not confirmed by analysis. Wherever this rough surface appeared there was discovered a curious sheath of hard clay about 1½ in. in thickness, which showed quite a marked cleavage from the mass of surrounding clay. When the surface of the caisson was smooth the sheath disappeared. Two photos were taken of this condition, and are here shown. One of the caissons has been dressed up a little to show the condition more clearly. There seemed to be some direct relation between the appearance of this sheath and the condition of the concrete surface. It was thought that there might be some chemical action going on which had caused a combination of certain elements of the cement with the clay, but an analysis of a sample of the hard clay did not confirm this. The clay analyzed as follows:

Loss on ignition	13.33%
Silica	50.94%
Alumina and Iron	30.85%
Calcium Oxide	3.87%
Magnesium Oxide	Trace.
Sulphur	Trace.

The condition may have been caused by pressure due to settlement of the caisson, but so far no satisfactory reason has been assigned. In some cases, at the bottom of the caisson where it had been belled out to get greater bearing surface, the concrete was practically loose stone without any bond whatever. If this condition can be produced by the action of ground water on concrete, then it is indeed full time that the question should be carefully investigated.

(3) The third case occurred in the foundation of the vault of the building last referred to. This consisted of a mattress in which steel I-Beams had been placed for reinforcement. In excavating under this mattress, preparatory to the construction of additional caissons, it was found that the concrete resembled close packed sandy gravel. It was quite soft, could easily be scraped away, and was water-soaked, clear through. When the under-lying clay was removed water dripped from the under surface of the concrete, and white stalactites were formed, sometimes as much as ¼ in. in diameter. The concrete seemed to have lost its character entirely, and a sieve analysis of a dried sample gave some extraordinay results. There was found no product finer than that retained on a 50-mesh sieve, and a microscopic examination of this product showed no trace of cement. It seems incredible that the cement should have disappeared in this way but it has not been established that it did not do so. In this particular case the actual history of the placing of the concrete would be of great interest, but this was found impossible to obtain. (This matter will be referred to in general remarks later on.) A photo of this concrete is here shown, but it is impossible to show much detail. The stalactites above referred to were analyzed and found to be Calcium Sulphate.

(4) The fourth case, also in the same building as the third instance, occurred in the concrete beams which had been constructed across the caissons to support the outside walls. These were reinforced with Steel I-beams, or as a matter of fact the concrete served as a protective coating for the steel. In the course of an examination of one of these beams the concrete was found to be rather soft, and at one point quite a large hole was discovered. The concrete on the side of the beam was easily laid off with a pick and the steel beam exposed. The beam was found to be very wet as water had penetrated into the heart of the beam and the resultant corrosion of the steel was quite marked. It was then decided to examine all the beams and as a result of the conditions found they were all stripped and a new concrete covering constructed. Arrangements for under drainage were also provided so that water could be kept away from the beams as much as possible. Several photos are shown which will give an idea of the conditions found. In one of the cases the concrete covering, if it had ever existed, had completely disappeared from the lower half. The space was spanned by a regular forest of small stalactites which had been formed by water dripping from the upper surfaces of the space. These were brown in color and on analysis were found to be composed of a combination of calcium and iron carbonate, the iron coming from the corrosive action of the water on the steel beam. On the bottom of the beam and lying also on the lower flange of the outside beam a slimy mass, similar in character to boiler sludge, was found in considerable quantity. This may have been a by-product from some chemical action by the ground water on the concrete of the beam. This case was somewhat complicated by the presence of manure which had been carelessly left on top of the caisson, where it had been placed as a protection from frost, as the chemicals in the manure might have had something to do with the condition found. The example is given, however, as a matter of interest, and a possible help in the investigation.

II. PIPES AND SEWERS.

(1) This is a matter which has been under observation for several years, both in Winnipeg and the neighboring City of St. Boniface, and was the reason for the starting of the series of experiments by the City analyst of Winnipeg. It has been the custom in Winnipeg, as in other cities, to construct sewers, either in place, or by the use of pre-moulded pipe and construction conditions are therefore subject to some variety. Conditions have developed which in several cases have resulted in a com-

plete collapse of the pipe and a consequent cave in of the ground surface. The first indication of disintegration is found in the appearance of soft patches in the interior of the pipe. These gradually extend until a hole develops or the pipe collapses. The appearance of the action on the interior was at first explained by the theory that it was due to the action of chemicals in the sewage, but as cases were observed in pipe which did not carry sewage this explanation did not hold. Experiments to date appear to indicate that a much more probable cause is the action of chemicals carried in ground water on the outside. This seems to be borne out by the fact that, in stretches of pipe made of the same materials and at the same time, disintegration will be found only in certain portions, thus pointing to local conditions acting from the outside. In the City of St. Boniface this local deterioration has also been observed. In one case a sewer disintegrated to such an extent that it collapsed and caused a cave-in under a railroad crossing, whereas in other parts of the same job the pipe appeared to be quite sound. Cases have been observed where disintegration occurred within six years from time of construction, but on the other hand pipe has been in the ground for over 35 years without any sign of decay. Samples illustrating these cases have been brought for examination. Perhaps the most serious case in Winnipeg was the collapse of a sewer on Yale Avenue about a year ago. This was built in place and had been in service for about ten years. It collapsed without any warning, and caused a cave-in of the street above. Sample of this pipe has also been brought for examination.

(2) Deterioration has also been found in manholes. These are usually constructed with pre-moulded rings. They exhibit the same tendency to deteriorate, but as in the case of the pipes above mentioned this deterioration has been local and not general. All this data seems to confirm the conclusion that outside agents are at work in certain localities.

GENERAL CONDITIONS

The above are given as typical examples of the trouble under discussion. Unfortunately it is practically impossible to get the true history of the concrete which has deteriorated. This is due in many cases to a lack of proper records, but more usually to a somewhat unpardonable reticence on the part of those concerned in the original construction of the concrete. It is therefore somewhat difficult to draw definite conclusions, and it will be impossible to get at the truth of the matter unless the concrete can be intelligently observed from its construction to its possible decay.

So many elements enter into the construction of concrete, such as materials used, the proportioning of same, time of year placed, condition of the ground and amount of ground water present, that only a series of carefully though out experiments can give a true line on the situation. If it is a fact that concrete constructed of carefully selected and tested materials, graded and mixed under intelligent and conscientious direction and placed under proper conditions as regards temperature, under drainage, etc. will deteriorate after remaining a few years underground, then it is full time that our Institute should take the matter in hand.

It would seem that an effective method of handling the situation would be the appointment of a working committee consisting of a practical engineer, a chemist and a laboratory man, which committee could be so financed by the Dominion Government, or by the Provincial Governments of the three Western Provinces, that they could devote their entire time to an investigation of the subject. Field work could be carried on during the summer months and data gathered on which to work during the winter. Laboratory work could of course be going on all the time. Field experiments could also be carried on, similar to those already in progress in the Western States, but adapted to our local conditions. A certain amount of investigation has already been done in Manitoba, and an attempt made to collect data on the subject, but up to date there has not been sufficient to arrive at any definite conclusions.

CHEMICAL INVESTIGATIONS

This matter, as above mentioned, has been carried on under the direction of the City Analyst of Winnipeg, who will himself give an account of his observations.

Speaking generally the work has consisted in the analysis of the clays of the Winnipeg District, samples of ground waters, and samples of deteriorated concrete, as compared with samples of sound concrete. As a result of these analyses chemical experiments have been undertaken with the object of determining the action of solutions of the various salts found in the ground waters, on neat cement and on mortar. Solutions have been concentrated and briquettes have been steam cured in order to arrive at results in the shortest possible time. Under construction conditions the process of deterioration is of course a very gradual one, taking several years before conditions become serious. In connection with these experiments some interesting results have been obtained by Mr. Thompson, who has been making experiments on the density of mortars.

Two main theories have been advanced to explain the deterioration of concrete by the action of chemicals in ground waters.

1. The formation of soluble compounds in the concrete which are leached out by the water.

2. The disintegration of the concrete due to expansion in the process of crystallization of the newly formed chemical compounds.

Results so far obtained from experiment will be presented but it was not considered advisable to publish same until they were more conclusive.

Concrete in Alkali Soil at Saskatoon*

By H. McI. Weir, M.E.I.C.

To be read at the Second General Professional Meeting, Saskatoon.

The following paper is presented to the Saskatoon meeting for the information of the members and in the hope that some way may be found to make the records of fact perfectly complete, and that a full and satisfactory explanation may be reached to account for the conditions of the concrete work herein discribed.—Editor.

The question of the disintegration of concrete in alkali soils has caused a great deal of discussion and considerable uneasiness among engineers throughout the West, especially within the last few years. The Engineering Institute has recently been making extensive inquiries in different localities and it was decided to discuss the subject at the Western Summer Meeting to be held in Saskatoon in August 1918.

In nothing a number of cases of damage to concrete structures in Saskatoon, caused supposedly in part by the action of alkali, it was hoped to be able to present some chemical results, but as there was no information as to the proportions of mix, nor any chemical analyses of the ingredients the results would not be of much value. After consulting with a chemist on the question it was decided to only give a description of the physical condition and appearance of a number of cases in alkali ground and compare these with conditions found in ground free from alkali. One case in particular is of interest because concrete blocks of the same manufacture have been used in different classes of soil with vastly different results.

The greater part of the concrete in Saskatoon is made with pit run gravel, generally clean but containing rather a small percentage of coarse material. There is, however, plenty of good concrete made from it, although it is desirable to add a further amount of broken stone or screened gravel to get best results. The water used in all cases, at least in late years, has been the same. Regarding the cement, the probabilities are that the largest part of it was a good product. In any case it is only fair to assume that even if some of the concrete under consideration was not of the best quality it was not all poorly made.

The main business section of Saskatoon is built on an alkali slough, which is still to be seen in some of the unbuilt portions of the down town district. Other parts of the city are quite different, there being no appearance of alkali.

The City was probably the first to experience any trouble in sub-surface structures—this in certain of their sewer manholes built in 1906-7 out of locally made cement blocks. As early as 1910 it was noticed that in certain localities the blocks were badly disintegrated; in other places they are still good. An example of this is on the Second Avenue sewer between 19th and 24th Streets where the manholes have had to be renewed, either wholly or in part, and some of them twice. The blocks were entirely disintegrated through their whole thickness. On the other hand the manholes built of these concrete blocks on this same sewer nearer its mouth, where it is built through ground free of alkali, are still in service and in good condition. Quite recently I examined several manholes on Avenue C, on the West side of the city, another district free of alkali. These manholes were built in 1907 of the same kind of blocks and were all in excellent condition. It would seem more than a coincidence that structures built of concrete blocks, made at the same time by the same workmen, should fail when placed in one kind of soil and give good service in another.

Case A, one of the first cases where foundations in a building were renewed was a warehouse building erected in 1907 on concrete foundations and pillars laid almost on the surface. No drainage was provided. It was decided to change the building partly to have a basement and partly on account of the very bad condition of the footings.

Case B which showed very bad disintegration was erected thirteen years ago. The floor in the basement has very little appearance of concrete, now, being little better than loose gravel. Apparently the question of drainage had been given very little or no attention, the cellar being very wet, and no doubt this fact would hasten the destruction of the concrete. In 1917 the owners made some repairs to the west wall and later in the same year the owners of the property immediately to the south erected a new building, excavating along the outer face of the south wall of this building, exposing it to its full depth. The wall was in a deplorable condition, one being able to dig the concrete out with a stick or the fingers to a depth of from six to nine inches. The wall, made from pit run graven, had been waterproofed with pitch or tar, which apparently had been no protection. One curious feature noted, and which might be a clew to some cure for alkali action, was that along a portion of the wall from the bottom up several feet, manure had been deposited between the wall and where the side of the excavation had been made. Where the concrete was protected by the manure it was hard and in good condition—everywhere else it was decidedly soft. The owners of the building had to have all the faulty concrete removed and re-poured in conjunction with that of the new building being erected.

In connection with case B, mention was made of the poor condition of the concrete floor, or what had once been concrete. This condition is to be noted in a great many of the buildings in this locality. One case C. was erected in 1912 almost immediately behind case B. Here although drainage has been attended to the floor is very poor; where it is cracked deposits of some white powder accumulated quite noticeably.

In 1912 a building was commenced on Second Avenue a little to the south of what may be styled case D. and in line with the south of that building. After pouring the footings and a portion of the wall and piers operations were stopped and were not recommenced until 1917 when two stores were erected by different parties other than the original owners. On examination of the concrete work it was found that all not exposed to contact with the

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soil and water was in first class condition, while the lower portions were as soft as so much mud The work had all to be removed and entirely new footings and walls poured.

At the same time this last mentioned building was being erected an opportunity was given to examine the basement wall of case D, as the building was made larger than originally planned and the excavation was extended to the rear where it abutted on the south face of the south wing of the hotel. The concrete in the hotel wall was easily removed to a depth of about two and one-half inches.

Last year a portion of the basement floor in a building, case E, was lowered and some of the footings were exposed. These were found to be soft to a depth of about one inch—not a very serious matter but rather disquieting in a building only a few years old.

This year the interior of a warehouse, case F, erected in 1909 was torn out and entirely rebuilt, including new footings. The new footings were placed in different positions from the old ones and as the new basement was excavated about four feet deeper than the original a good opportunity was given to observe the old concrete. Broken stone had been used as aggregate and the interior was good hard concrete. The outer face, however, was soft to a depth of about two or three inches, except in a few places near corners where it was easily broken off to a depth of five inches. This outer portion, like that in case B, was easily removed with the fingers.

Another building, case G, a part of the footings of which were exposed this year, was erected in 1911 and destroyed by fire early this year. At the present time re-construction is under way with an addition on the north side. The old foundations are being used and the excavation for the new portion exposed part of the footings. It is quite apparent that some agency has softened the outer face to a depth of about two inches. The weeping tile in this building was laid on top of the lower course of the footings and it is to be noticed that concrete broken off near this tile is not as soft as that at the very bottom, about eighteen inches lower, where it was quite wet. A white deposit was very noticeable here and there throughout the concrete, wherever there was room for it to lodge. This condition is observed in all these cases. Another point noted was that a portion of the concrete where the forms had been left on was in better condition than where they had been removed at the time of construction.

The City has had other troubles with concrete besides the manholes mentioned before; this at the subways built under the Canadian Northern Railway at 19th Street and 23rd Street. The 19th Street Subway was built in 1911-12 with concrete made from pit run gravel and it might be mentioned that the cement was supplied by the City, or rather by the City and the Railway Company as they shared the expense of construction, so there was small possibility, as is so often the case, of the cement being a little shy in the mix, the contractor having nothing to gain thereby. Ample drainage was supplied at the foundations but the surface water did not get away readily as the back-filling was of impervious material. This water seeped through the wall at vertical expansion joints placed at intervals along its length and disintegrated the concrete at the joints very badly. This condition became so bad, and also on account of this water flowing over the sidewalks, the City a few years ago removed the back-filling and replaced it with cinders and gravel. A certain amount of water still gets through but the condition is much improved and no doubt will save the rear of the wall.

In the 23rd Street subway built in 1912-13 of pit run gravel the same conditions are to be observed in places, although to a lesser extent as a part of the back-filling was done with cinders and the resulting drainage is much better. In this subway, as in the other, the cement was supplied to the contractor and was all tested also there was an inspector on the work at all times. The face of the two abutments under the railway had to be renewed last year. The damage here was caused partly from the action of water seeping through the joints but there were also several longitudinal streaks of poor concrete which appeared to be caused from deposits of laitance.

All the cases mentioned above are in the district described as the down town section and a former slough. That of a cereal building is an example of concrete placed in a different section of the city, in sandy soil apparently quite free from any traces of alkali. At the present time they are erecting new buildings and tanks and have exposed two long faces of concrete from the ground level to the footings. This concrete, which is made with crushed rock, is so hard that a moderate blow from a pick gives no result but a ring and a jar to the arm. The outer face is so hard that no mark is made unless from a heavy blow.

The combined work of chemist and engineer will be required to arrive at any absolute and definite statement that the action of alkaline soils and waters is injurious to concrete structures and provide a preventive for such injury. The cases described, even though they are not backed by any chemical tests or facts, have at least demonstrated certain practical examples that would lead one to believe.

(1) That concrete deposited in alkali soils is subject to disintegration whereas in soils free from alkali it stands up well.

(2) That dense concrete made of proper proportions, preferably with broken stone and a rich mix is better than from pit run gravel. Care being taken to have voids as few as possible.

(3) That proper drainage helps to preserve concrete in alkaline soils.

(4) That water proofing with pitch or tar may not prevent alkaline action on concrete.

It might be well for the Institute to provide funds for the carrying out of tests on large concrete blocks made from tested materials, some to be placed in alkali ground and others in soil free from alkali. As these tests would necessarily extend over a considerable number of years they could be carried out in the vicinity of one of our Universities and preferably with some of the University staff on the personnel of the committee appointed to carry out the investigations, as this would assure the work being always under observation.

FUELS OF WESTERN CANADA*

By James White, M.E.I.C.

(To be read at the Second General Professional Meeting, Saskatoon.)

The principal fuels of Western Canada are: Coal, Natural Gas, Petroleum, Electricity, Peat, Wood.

COAL

Coal is, of course, much the most important fuel of Western Canada, and ranges from the lignite of the prairies to the semi-anthracite of the Rocky mountains.

The "Coal Fields & Coal Resources of Canada" * contains a statement of the coal resources of the Dominion. This statement of reserves is divided into two groups.

Group I includes "coal in seams containing not less than 1 foot of merchantable coal occurring not more than 4,000 feet below the surface, including workable submarine areas". This group, Mr. Dowling states, includes the coal "of economic value contained in seams of workable thickness, situated within a mineable distance of the surface."

Group II includes seams containing not less than 2 feet of merchantable coal occurring at depths between 4,000 and 6,000 feet. Such seams are situated beyond present mineable distance of the surface and have not been considered in this paper.

Both groups are subdivided into (1) "Actual Reserve", which includes cases in which the calculation of the amount was "based on a knowledge of the actual thickness and extent of the seams"; (2) Probable Reserves, which includes "cases in which an approximate estimate only" could be arrived at.

At the present time, to be economically "workable", a seam must be more than 1 foot thick and no coal mine in Canada approaches 4,000 feet in depth, though, in the Crowsnest district some workings have a "cover" of several thousand feet. At great depths, the greatly increased ventilation is a matter of expense and difficulty; creeps and subsidences of strata are unavoidable, and either crush the coal or render it inaccessible; the capital and current expenditure of the mine grows in a higher proportion than the depths; the costs of raising water, coal, miners, etc., increase.

Mr. Dowling's estimate of the coal reserves in Group I is as follows:

ACTUAL RESERVES

(Calculation based on actual thickness and extent)

	Lignite	Lignite or Sub-bituminous	Low carbon bituminous	Bituminous and high carbon bituminous	Semi-Anthracite	Total
	Metric tons	Metric tons	Metric tons	Metric tons	Metric tons	Metric tons
Saskatchewan......	2,412,000,000					2,412,000,000
Alberta...........		382,500,000,000	1,197,000,000	2,026,800,000	669,000,000	∅386,372,800,000
British Columbia..		60,000,000	118,000,000	§23,653,242,000		23,831,242,000
	2,412,000,000	382,560,000,000	1,315,000,000	25,680,042,000	669,000,000	412,616,042,000

PROBABLE RESERVES

(Approximate estimate)

	Lignite	Lignite or Sub-bituminous	Low carbon bituminous	Bituminous and high-carbon bituminous	Semi-Anthracite	Total
	Metric tons	Metric tons	Metric tons	Metric tons	Metric tons	Metric tons
Manitoba..	160,000,000					160,000,000
Saskatchewan.....	57,400,000,000					57,400,000,000
Alberta...........	26,450,000,000	464,821,000,000	139,161,000,000	§43,022,000,000	100,000,000	673,554,600,000
British Columbia..		5,136,000,000	2,300,000,000	§∅42,607,700,000		50,043,700,000
	84,010,000,000	469,957,000,000	141,461,000,000	85,630,300,000	100,000,000	781,158,300,000

§Includes semi-anthracite.
∅Total after deducting 20,000,000 tons mined to 1911.
§∅Includes 1,800,000,000 tons of cannel.

As the above estimate includes seams as thin as 1 foot, they include many seams that are, under present conditions, not economically workable and many that are too low grade to be of present value.

Total coal in Western Canada (Group 1)	tons	Per cent
Manitoba........	160,000,000	0.1
Saskatchewan.....	59,812,000,000	6.1
Alberta...........	1,059,927,400,000	88.8
British Columbia	73,874,942,000	5.0
	1,193,774,342,000	

*For the purposes of this paper, Western Canada is taken as including Manitoba, Saskatchewan, Alberta and British Columbia, but not including Yukon or the North West Territories.

*The writer desires to express his indebtedness to the report on the "Coal Fields and Coal Resources of Canada" by Mr. D. B. Dowling, Geological Survey of Canada.

Manitoba

In Manitoba, the Turtle Mountain coal-field occupies an area of about 48 square miles. About 1890, an attempt to mine coal was made near Goodlands but was unsuccessful doubtless due to the quality and the thinness of the seams. Coal has also been mined near Deloraine but only for local use. The insignificance of the production is indicated by the fact that the Annual Report on the Mineral Production of Canada, published by the Mines Branch, Ottawa, gives no statistics of coal production in Manitoba. The "probable", not "actual", reserves are estimated at 160 million tons of lignite.

Mr. D. B. Dowling states that "the coal horizon does not appear to consist of a series of seams in continuous sheets but rather of deposits which are limited in extent though repeated over large areas. A thick seam may thus be represented in an adjoining locality by a series of thin seams separated by sheets of sand or clay".

Saskatchewan

In Saskatchewan, two coal-bearing formations are exposed, namely, (1) The Belly River formation of the Cretaceous and (2) Tertiary, which is much more important than the Cretaceous and underlie the Estevan district, Wood-mountain and the Missouri coteau. The two principal fields are roughly triangular in shape. The first is bounded on the east by a line extending from the vicinity of Carnduff to the Old Wives lakes, on the west by a line thence to the international boundary west of Wood Mountain and by the international boundary. The second field extends from the boundary between Saskatchewan and Alberta to the vicinity of Swift Current and includes the eastern portion of the Cypress hills.

The Souris valley is about 120 feet deep near Estevan, and presents peculiarly advantageous conditions for prospecting and for mining the seams that outcrop in its banks and in the tributary gullies and ravines. Though there can be little doubt that enormous areas in Saskatchewan are underlain by coal seams, the heavy covering of boulder-clay conceals their outcrops and, except in occasional rock exposures in the hill sides and stream valleys, their existence can only be determined by boring.

At the Estevan mines, most of the coal is produced from the lower measures which, at this point, have a thickness of 8 feet of coal. In the western portion of the district, the seam splits up into several small seams but it is reported that, to the northeast, it increases to 15 feet.

Coal has also been reported near Cullen, 16 ft., Arcola, 14 ft., Wauchope, 8 ft. and in a number of localities, particularly in the Wood Mountain and Cypress Hills districts.

Coal has been found in borings or natural exposures of rocks of the Belly River formation in the western portion of Saskatchewan, notably at Maple Creek, Brock and Salvador. It carries from 27 to 34 per cent fixed carbon.

Coal carrying 35 per cent fixed carbon has also been found in the Dakota sandstone (Cretaceous) near Lac la Ronge.

It is estimated that in Saskatchewan, an area of 13,100 sq. miles is underlain by coal seams.

Alberta

As indicated in the table on page 3, it has been estimated that the "actual" and probable reserves of coal in Alberta aggregate 1,059,927 million tons, which constitutes 87 per cent of the coal in Canada.

The coal horizons in Alberta are:

(1) Edmonton and part of Paskapoo formation
(2) Belly River formation
(3) Kootenay formation

Coal is found in the Tertiary rocks but most of the seams are generally too thin to mine.

Edmonton Formation.—Of the total area, 24,779 sq. miles, occupied by the Edmonton and Paskapoo beds, 22,475 sq. miles is assumed to be underlain by coal. The "actual" and "probable" reserves in these beds aggregate 789,600 million tons of lignite or sub-bituminous coal and 11,358 million tons of low carbon bituminous.

The Edmonton formation forms a wide trough lying approximately parallel to the Rockies and extending from the international boundary to about lat. 55-30′. The central portion of the trough is occupied by Tertiary sandstones.

The "Big" coal seam, which is 25 feet thick where it outcrops off the North Saskatchewan, consists of two 10-foot seams near the Grand Trunk Pacific crossing of the Pembina river. It is 10 feet thick on the Red Deer river near Alix, but decreases to about 5 feet south of the Bow river.

Another very persistent coal horizon is found 500 to 600 feet below the Big Seam. At Calgary, where it has been found in a bore-hole 1,800 feet below the surface, it is 13 feet thick, near Drumheller it is 6 ft. 10 in. thick, on Battle river it has a thickness of 4 feet. At Edmonton, there are two seams of good domestic coal, each about 6 feet thick. It is mined at Drumheller, Tofield, Edmonton and other points.

Belly River Formation.—The Belly River formation occupies a considerable area in the south-eastern portion of the province. The most important seams in this formation are exposed at Lethbridge. At this point, the main seam is 5 ft. 6 in. in thickness. Near Taber there is a seam 3 ft. 3 in. thick and, at Stair, there are two seams, 4 ft. and 5 ft. 3 in. Near Peace River canon, seams up to 9 feet in thickness have been reported. The discovery of a 4-foot and a 7-foot seam at Maple Creek, at depths of 197 and 292 ft., respectively, indicates that it contains workable seams as far east as southern Saskatchewan.

What is assumed to be the "upper" seam has been found at Tofield at a depth of 1,050 feet and, at Edmonton at a depth of 1,400 feet, where it was 6 feet thick. At Calgary, a 5-foot seam found at 2,562 ft., a 7-foot seam at 2,656 feet and a 4-foot seam at 2,875 ft. are believed to be in the Belly River formation.

The Kootenay Formation.—The Kootenay formation is exposed in and near the Rocky mountains. As a result of the great uplift of the Rockies, the upper measures were denuded and only remnants of the lowest division

of the Cretaceous— the Kootenay — survived. These remnants are usually found occupying valleys between the mountain ranges, the mountains having served as a protecting agency. At the same time, the crumpling and folding of the strata during the uplift of the mountains has given us a coal that, in places, is semi-anthracite or is anthracitic. This coal is the highest grade found in the Prairie Provinces.

In Alberta, the three principal seams in the Coleman area have a thickness of 16 ft., 10 ft. and 8 ft. respectively. In the Blairmore area there are seams 10, 17, 3½, 3½, 17 and 6 feet thick, respectively. A seam 20 feet thick has been reported in the Moose Mountain area.

In the Banff area, the coal varies from anthracite to bituminous. In the south-eastern portion of the field, there is a toal thickness of coal of from 41 to 86 feet. At Bankhead, the workings have cut seams 3 ft., 7 ft. (in thin bands), 8 ft., 19 ft. in two benches, 13 ft. in three benches, and 6 ft. thick, respectively.

In the Bighorn basin, seams aggregating about 60 ft. of workable coal have been found. Seams of 21 ft., 7½ ft. and 4½ ft. are being mined at Mountain Park.

Coal is also found in the Kootenay formation at numerous other points in the Rockies and in the foothills. On the Muskeg river, seams, 11½ ft. 25 ft. and 7 ft. thick, respectively, have been found.

The coal production of Alberta, in 1916, amounted to 4,559,056 tons, valued at $11,386,577. The Chief Inspector of Coal Mines for Alberta states that the total sales in Canada were 4,227,164 tons; that 2,956,205 tons were sold for consumption in Alberta, 1,021,656 tons in Saskatchewan, 98,629 tons in Manitoba, 89,582 tons in Alberta and 61,092 in the United States.

British Columbia

The Crowsnest Coal-field.—The Crowsnest coal-field is the most important body of coal that is being mined in British Columbia. It includes an area of 230 square miles. The coal is a high-grade bituminous, occasionally running into anthracitic, averaging about 64 per cent fixed carbon. Much the greater portion of the coal is converted into coke, the remainder being sold as steam coal. There are 22 workable seams, with a total thickness of 216 feet, 100 feet of which is estimated as workable.

In addition to the Crowsnest field referred to above, areas of coal-bearing rocks are found at several points in southern British Columbia.

The Princeton field includes an area of about 50 square miles. At Princeton, there is an 18½ ft. seam of lignite carrying 42 per cent fixed carbon, 38 per cent volatile matter and 16 per cent moisture.

At Nicola, seams 6 ft., 10 ft., 5 ft. and 12 ft. thick, respectively, have been mined. The coal is a sub-bituminous and analyzes about 47 per cent fixed carbon, 39 per cent volatile and 4 per cent moisture.

Coal has also been found at Tulameen, Kamloops, Hat Creek and North Thompson River.

Vancouver Island Coals

The total area in Vancouver Island underlain by coal seams is about 600 square miles. These coal-fields contain some of the best steam coals on the Pacific coast.

The coal of the Comox field is coking bituminous and contains 57.2 per cent of fixed carbon, the highest carbon content of all the Vancouver Island coals. Three seams have been mined in this field.

The Nanaimo field has a productive area of 65 square miles, though the area underlain by coal seams is somewhat larger. The seams vary in thickness. Occasionally a seam containing from 2 or 3 feet of dirty coal carries 30 feet of clean coal at a point only 100 feet distant. Analyses of run-of-mine coal from this field range from 45.5 per cent to 56.23 per cent fixed carbon and from 33.3 per cent to 43.25 per cent volatile combustible; commercial samples, 12,470 to 13,160 British thermal units.

The Suquash field contains at least two seams that are workable. The seams in this field are regular but are thin and contain a large number of persistent partings. The coal is a low carbon bituminous. It analyzes 42.07 per cent fixed carbon, 37.27 per cent volatile combustible and 5.63 per cent water.

The coal-fields of the Queen Charlotte islands are of Cretaceous and Tertiary age. The Cretaceous coals range from semi-anthracite to low-carbon bituminous. The Tertiary coals are lignites.

In 1871, mines were opened in the semi-anthracite at Cowgitz but the coal was so badly crushed that the enterprise was abandoned. This coal analysed 83.09 per cent fixed carbon and 5.02 per cent volatile combustible; fuel ratio 16.5.

Central British Columbia

Lignite is found at Alexandria, Quesnel and Prince George on the Fraser, on the Nazoo river, Nechako river, Dean river and Lightning creek. Three seams of bituminous coal, possibly a coking coal, aggregating 20 ft., have been reported on a tributary of Morice river and three seams on Goat tributary of the Telkwa, aggregate 56 feet in thickness.

Northern British Columbia

The most important coals thus far discovered in this region are the semi-anthracites and anthracites of the Groundhog Mountain area. An area of 170 square miles is assumed to be coal-bearing and contains 8 seams with an aggregate thickness of 30 feet.

Lignites have been discovered on Kispiox river, Sustut river, Peace river and Liard river. Bituminous coal has been found near Peace River canon and on the Taku river.

Coal Production.—In the calendar year 1916, the production of the Prairie Provinces and British Columbia was:

	Tons	Per cent of Canada's Production	Value
Saskatchewan.......	281,300	1.94	$ 441,836
Alberta.............	4,559,054	31.48	11,386,577
British Columbia....	2,584,061	17.84	8,075,190
	7,424,415		

Imports of Coal.—In the year ending March 31, 1917, the imports into the Prairie Provinces, British Columbia and the portion of Ontario lying to the west of lake Superior were:

	Tons	Value
Bituminous lump	2,067,416	$2,850,121
Bituminous slack	260,197	337,655
Anthracite	521,611	2,924,308
	2,849,324	$6,112,084

The statistics quoted show that over 93 per cent of the coal ("Actual Reserve") in Western Canada is lignite or sub-bituminous. It has often been stated that the coal problem in Canada is the supplying coal to a coalless Central Canada from coal-fields situated in the eastern and western portions of the Dominion. In Manitoba and Saskatchewan it is also a problem to utilize the lignite coal to advantage.

As is well known, lignite is difficult to transport without loss from slacking and from crushing. It is mined in large blocks but breaks up easily on exposure to the air. This disintegration is due, in large part, to the evaporation of its water which constitutes from 20 to 35 per cent of the lignite. The evaporation of this moisture causes splitting of the lumps eventually converting them into slack. When air dried, it contains about 26 per cent moisture, about 32 per cent volatile matter, and 36 per cent fixed carbon. It is generally shipped in box cars and stored in closed sheds. Its friable nature also causes a large loss in mining.

Therefore, the greater problem in Western Canada, particularly in Manitoba and Saskatchewan, is the question of procuring fuel that will approximate to anthracite in heating value and in convenience of handling. At present, owing to the war, abnormal conditions prevail and antracite is almost unobtainable west of lake Superior. It has been predicted that, when the war is over and conditions approximate to normal, hard coal will be marketed at a lower price. An examination of prices during the last 20 or 25 years, however, and the well established fact that, at the present rate of consumption the anthracite of the United States would be exhausted in less than a century, indicate that the theory of lower prices after the war is utterly fallacious. Even prior to the war, the production was decreasing at the rate or approximately one per cent per annum. The question therefore is: What can be done in the way of producing a fuel that approximates to anthracite, or toward the production and utilization of lignite under more advantageous conditions.

The briquetting of carbonized lignite promises to furnish a product that will rival anthracite. So far as the writer knows, however, no plant has yet produced it on a commercial scale though the Dominion Government has appropriated $200,000 for that purpose, this sum to be supplemented by votes of $100,000 each, by Manitoba and Saskatchewan.

In 1917, B. F. Haanel, M.E.I.C., of the Mines Branch, Dept. of Mines, investigated the manufacture, costs, etc. of carbonized lignite briquettes and reported that a plant with a capacity of 30,000 tons could produce the briquettes for $7.25 per ton, assuming that the lignite, half slack and half run-of-mine, required to produce one ton of briquettes could be purchased for $1.12½. As the production of slack in 1917, at the principal mines in the Estevan distr'ct was only 55,000 tons, it is obvious that all lignite required over and above this amount would be run-of-mine which, on the basis of costs in 1917, increases the cost of the briquettes 75 cents per ton, or $8.00 in all.

In 1917, the Commission of Conservation instructed their mining engineer, W. J. Dick, M.E.I.C., to make an investigation of markets, freight rates and cost and tonnage of lignite in the Estevan district. Mr. Dick reported that, based on the figure for operating expenses prepared by Mr. Haanel, allowing the manufacturer a profit of $1.00 per ton, the briquettes could be marketed at a lower price than anthracite in western Manitoba and Saskatchewan, the price ranging from 45 cents per ton less in Portage-la-Prairie to about $2.00 per ton less in Moose Jaw. If run-of-mine coal is used, it will, of course, decrease this profit by 75 cents, but will leave an ample margin in the Regina and Moose Jaw markets.

In manufacturing carbonized lignite briquettes, the raw material is heated in closed retorts to drive off the moisture and nearly all the volatile matter, the carbonised material being left behind as a coke which contains about double the amount of fixed carbon contained in the raw lignite. This carbonized material is mixed with a binder and compressed in a briquetting machine. Subsequently the briquettes are waterproofed by heating the binder to coke it.

The question of the material to be used as a binder is an important one. Coal tar pitch makes an excellent binder but it is reported that the cost is high. The quantity available in Canada is also somewhat limited. Sulphite pitch, produced in the manufacture of paper pulp, has been successfully used as a binder in experimental work.

Pulverized Fuel.—Pulverized coal was first utilized in cement plants and was found to be an excellent low-priced fuel of high efficiency. Later, it was applied in certain metallurgical processes and, during the last four years, several United States railways have successfully operated locomotives with this class of fuel.

In Copper smelting, notable results have been achieved, furnaces with a rated smelting capacity of 500 tons of ore per day, are now smelting twice that amount with pulverized coal. Notable economies have been obtained where it has replaced oil fuel, and a better distribution of heat was obtained. Mr. W. G. Wilcox states that by comminution "we have changed entirely the characteristics of coal as commonly known".

In addition to the greatly increased efficiency obtained, pulverized coal is practically smokeless, small coal can be utilized, inferior grades can be mixed with better grades and burned successfully and the labour of the fireman is reduced to a minimum.

To obtain the best results, about 85 per cent should pass a 200-mesh screen and it should contain not more than 1 per cent of moisture. After being reduced to this high degree of fineness and blown through a burner nozzle the volatile gases of the pulverized coal ignite instantly. The fixed carbon is consumed by the heat

of the volatiles, the flame resembling an oil or gas flame. By increasing or decreasing the supply of air or fuel, the operator regulates the supplies and has the operation under absolute control.

Where a coking coal is obtainable at a reasonable price, the establishment of central coking plants near large centres of population seems to offer the maximum of advantage. Such a plant would produce a coke or artificial anthracite, gas, for cooking or heating, coal tar which contains the elements entering into the manufacture of a whole series of valuable substances, benzol, toluol and other raw materials for explosives, aniline oil whence aniline dyes are manufactured, and ammonia liquor from which is produced sulphate of ammonia, a valuable fertilizer. The coke thus produced can be used for all purposes for which anthracite is used. It requires a little more care in firing and furnaces burning coke require a somewhat larger fire box than for hard coal.

Mr. Dick estimates that a plant established in Toronto would not only supply 300,000 tons of such coke "cheaper than anthracite, but would supply 1,500,000 M. cu. ft. of gas at a cost of 10 cents per thousand at the plant".

Whether such coke plant be municipal or privately-owned, it offers what is, at the present time, the most promising solution of the fuel question in Saskatchewan, Manitoba, Ontario and Quebec.

Owing to the slacking and crushing due to evaporation of the contained moisture, the mining of lignite is carried on in the autumn and winter though the mines could be more efficiently operated in summer. To permit mining in summer and to avoid slacking, it has been suggested that the lignite lump be put in pits in the ground and covered with earth, the covering being wetted from time to time, if necessary.

W. F. Brereton, M.E.I.C., city engineer of Winnipeg, states that good results have been attained by piling the lignite on the surface and covering it with slack.

An application has been made for patent on storing lignite lump in pits with masonry or concrete walls and bottom, but it is doubtful whether this is a patentable device.

NATURAL GAS

No reservoirs of natural gas have, as yet, been discovered in Manitoba or Saskatchewan. Gas has been reported at Morden, Man. and at Pense, Estevan, Hanley and North Hanley, Sask. but not in commercial quantities.

In Alberta, four important gas-fields have been discovered, namely, the Medicine Hat, Bow Island, Viking and Pelican Rapids fields. The gas is derived from the Nibrara in the Medicine Hat and Viking fields and from the Dakota sandstone in the Medicine Hat and Pelican Rapids fields.

Three anticlinal arches have been found. The first extends from the Sweet Grass hills in Montana, thence northwestward to the Bow river. The Bow Island field is near the axis of this anticline. The second anticline extends nortwestward from the Saskatchewan—Alberta boundary in approximate latitude 52° to Viking. The third anticline crosses the Athabaska river about 20 miles above McMurray and, like the first and second, has a general northwest-and-southeast course.

Medicine Hat Gas-field.—In the Medicine Hat gas-field there are 33 wells with an approximate capacity open flow* of from 90,000,000 to 92,000,000 cubic feet per day, which is equivalent to about 53,000,000 feet, working capacity. The largest well, the Tuno, has been reported to have a capacity of 6,000,000 feet per day. The tested portion of this field has an area of about 30 square miles. The initial rock pressure was about 600 lbs. to the square inch. The gas-sand is found at a depth of from 1,000 to 1,200 feet and is about 900 feet above the Dakota sandstone. This field supplies Medicine Hat, Redcliffe and the vicinity.

The Bow Island gas-field has a tested area of about 25 square miles; the initial rock pressure was 790 lbs. and the gas-sand was found in the Dakota sandstone and at a depth of from 1,850 to 2,150 feet. This field supplies Macleod, Lethbridge, Calgary and the intermediate towns by a 16-inch pipe-line, 175 miles long. There are 21 wells drilled in this field and the total daily capacity, open flow, is about 186 million cubic feet. No. 4 well has a capacity of 29 million cubic ft. At Foremost, 36 miles south of Bow Island, a well has an estimated open flow of 13,000,000 cubic feet per day. A heavy oil sand found at Foremost, 920 feet below the gas sand suggests a possible source for the gas.

Gas has also been found at Langevin, Cassils, Brooks and other points on the main line of the Canadian Pacific, in smaller quantities and in sands which are, respectively, 1,400, 800 and 300 feet above the horizon of the Medicine Hat gas-sand.

In the Viking field, gas has been found in the Dakota sandstone, at the depth of about 2,350 feet and in the Grand Rapids sandstone, at a depth of about 2,200 feet. The tested area is about 12 square miles. There are 3 wells in the Viking field with a total daily capacity of 39½ million cubic feet per 24 hours. The average rock pressure is 700 lbs. It is proposed to pipe this gas to Edmonton, 30 miles, and to produce gasolene by absorption from it. There are two gas horizons, at 2,150 feet and at 2,350 feet, the upper sand yielding more gas.

A well at Vegreville, 30 miles northwest of Viking, has a flow of from 200,000 to 300,000 cubic feet per day. At Wetaskiwin, 40 miles south of Edmonton, a gas well has an open flow capacity of 300,000 to 350,000 feet. At Pelican Rapids, on the Athabaska river, 160 miles north of Edmonton, a heavy flow of gas was struck in the Dakota sandstone at a depth of 800 feet when drilling for oil in 1897. Gas has also been found in a deeper well, in the Devonian limestone. The wells at Pelican are reported to have a combined capacity of less than 1,000,000 cubic feet per day.

In 1917, the production of natural gas in Alberta was 6,744 million cubic feet, valued at $1,299,976 as sold by the producing companies.

*Under working conditions a well may be assumed to deliver about 60 per cent of the open flow capacity.

PETROLEUM

Up to the present time, with the possible exception of the Peace River Landing wells, oil in considerable quantities has not been found in Western Canada. Respecting the possibility that petroleum will be discovered, particularly in the Viking area and the Peace and Athabaska valleys, the situation may be summed up as very promising.

In the year ending March 31, 1917, we imported into Western Canada, for fuel purposes, 95,693,497 gallons of petroleum, valued at $2,738,555. For refining, we imported in the same year 35,313,717 gallons, valued at $1,040,047. If extensive oil-fields are discovered in Alberta or Saskatchewan, we will retain in Canada at least $3,750,000 which we are now paying for petroleum importations and an additional $1,250,000 paid for petroleum products such as gasolene and kerossene, or, in all, $5,000,000.

A small quantity of dark oil obtained in one of the wells in the Viking gas-field is an encouraging indication and oil has also been found in the Pelican Rapids gas-well, Seepages of oil have been found near Waterton lake, in southwestern Alberta and in the Flathead valley in southeastern British Columbia.

In northern Alberta, there are enormous tar seepages, which evidence an upwelling of petroleum unequalled elsewhere in the world. Along the Athabaska river, they extend from Pelican rapids to fort McKay, a distance of over 100 miles. The known occurrences indicate that there is in sight at least 6½ cubic miles of bitumen and the petroleum from which it was derived must have been many times greater. While this enormous amount of petroleum has escaped, there must be untapped reservoirs in the Devonian limestones whence it was derived. Similar seepages occur near the Peace and Mackenzie rivers. Near Peace River Landing, oil has been found in two wells, 900 and 1,200 feet deep, respectively, and is unofficially reported to be in commercial quantities.

In Southwestern Alberta, the Southern Alberta oil Co's well is reported to be yielding between 35 and 50 barrels of oil per day. This company is producing kerosene and gasolene. The Dingman gas-well is yielding 20 to 30 gallons of gasolene per day.

It is reported that 294,000 gallons of gasolene and kerosene were recovered during 1917 from Alberta crude oils. Statistics of the small production of crude oil in Alberta during 1917 are not yet available.

ELECTRIC ENERGY

In western Canada, electric energy in large quantities for use as fuel is not economically available at the present time except in certain favoured localities in southern Manitoba and southern British Columbia.

In Manitoba, there are on the Winnipeg river, two developed powers and seven undeveloped powers ranging from 9,900 to 57,300 h. p. at 75 per cent efficiency on a 24-hour basis and assumed minimum flow of 12,000 sec. ft. With a regulated flow of 20,000 sec. ft., these powers would range from a minimum of 12,300 h. p. to a maximum of 95,500 h. p. The total power with unregulated river (12,000 sec. ft.) is 249,300 h. p. and with regulated river (20,000 sec. ft.) is 418,500 h. p.

The Grand rapid of the Saskatchewan has 32,600 h. p. with an assumed minimum flow of 4,500 sec. ft. It is not improbable, however, that the flow sometimes falls to about 3,500 sec. ft.

There are large powers on the Nelson, Churchill and Athabaska rivers, at Fort Smith rapids on the Slave and at Vermilion and Peace canon on Peace river but detailed information respecting the low water flow of these rivers is not available. In some instances, low banks and lack of concentrated fall would make development very costly.

In British Columbia, there are many important water powers. Some of the principal powers near centres of population or possible large commercial developments are:

On the Kootenay, at Bonnington Falls, 125,000 h. p., and at Lower Bonnington, 22,000 h. p., at Stones Byres, 50,000 h. p.; on the Pend d'Oreille, near Waneta, four powers ranging from 32,000 to 73,000 h.p., at Long rapid on the Columbia, 30,000 h. p.; 52,000 h. p. at upper site on Stave river and 52,000 at lower site; 30,000 h. p. in Nahatlach river; in Adams river, 30,000 h. p.; Bridge River tunnel, 70,000 h. p.; South fork Quesnel river, 90,000 h.p.; Campbell river, a possible 100,000 h. p.; Jordan river, 25,000 h. p. at present and 38,000 h. p. ultimate; Coquitlam lake, 84,000 h. p.; Bear Mount canon on the Cheakamus, 40,000 h. p.; Powell river, ultimate development, 32,000 h. p. It has been estimated that there is 200,000 h. p. in the Fraser between Yale and Lytton and 100,000 in the Thompson river canon but, owing to the railways in these canons, it is doubtful whether these powers can be developed.

With anthracite coal at $10.00 per ton and burned at 50 per cent efficiency and with electric energy at one cent per kilowatt-hour, the coal will yield 14,000 b.t.u. for one cent as compared with 3,412 b.t.u. from the electric energy for one cent. This demonstrates that, on this basis, heating by electric energy would be four times as costly as with coal. The 2,100,000 inhabitants of Western Canada would require not less than 10,500,000 electrical horse power for heating alone.

As the hydro-electric energy already developed in Western Canada aggregates about 359,000 h. p. (76,000 in Manitoba, 33,000 in Alberta and 250,000 in British Columbia), it would require 29 times this amount to heat the homes in Western Canada. Again, as the total electric energy already developed in the whole of Canada is only about 1,800,000 h. p., it would require nearly six times this amount to replace the fuel used in the Prairie Provinces and British Columbia.

Again the total water power in the Prairie Provinces is about 3,500,000 h. p., and in British Columbia, 2,500,000 h. p.* Even assuming that it would be possible to utilize the powers in the northern portion of the Prairie Provinces and British Columbia and the numerous small powers, the aggregate would still be 4,500,000 h. p. short of the heating requirements of that region.

PEAT

During the last half century, numerous attempts have been made in Canada to manufacture a commercial peat fuel. In 1910, Dr. E. Haanel, Director, Mines Branch, stated that, up to that time, the attempts "have been failures and very little peat fuel is at present available.

The chief cause of most of these failures has been in the ignorance of the nature of peat on the part of those who have engaged in the production of peat-fuel. In several instances the bogs chosen for the work have been unsuitable for the purpose in view. A proper investigation of the bog previous to the commencement of operations was seldom made; consequently, methods entirely unsuitable for the utilization of the bog in question have been employed, and the result has been failure. These failures, involving as they did considerable loss of capital, have created a profound distrust of everything connected with peat and the utilization of peat bogs."

Peat, as found in nature, contains about 10 per cent combustible matter and 90 per cent water, the removal of this exceedingly high proportion of water constituting the great problem for the peat engineer. Dr. Haanel states that it has been "demonstrated, once and for all, that the water content of raw peat can not be reduced much below 80 per cent by pressure alone, and the process of wet carbonizing, upon which large sums have been expended, has not, up to this time, proved a success. In fact, it may be safe to make the statement that any process for the manufacture of peat-fuel which depends upon the employment of artificial heat for the evaporation of the moisture will not prove economic. The only economic process in existence at the present time is that which utilizes the sun's heat and the wind for the removal of the moisture."

Mr. A. Anrep, Mines Branch, Dept. of Mines, has investigated 18 bogs in Manitoba. He reports that there are bogs in the Winnipeg River district containing 1,860,000 tons of peat-fuel, 25 per cent moisture.

With its enormous coal resources, however, Western Canada will, for many years, depend upon coal and wood for heating and cooking. At the resent time, the high labour cost, alone, is sufficient to render peat manufacture an unprofitable enterprise.

In Western Canada, to meet the abnormal conditions created by the war, peat may be prepared and stored on a small scale by farming communities and villages where such are situated near peat bogs. Such fuel supply would not only increase the fuel supply particularly during the autumn and spring but would release railway cars that are urgently needed for other purposes.

The water in the peat should be reduced to 25 to 30 per cent before it can be used as fuel. The season for drying peat begins as soon as the frost is out of the ground and ends in September. The bogs should be drained and the turf removed from its surface. The peat is cut in blocks about 9 in. by 4 in. and from 3 to 6 in. thick. At the end of about four weeks they are ready for storage. During this period they should be kept covered and should be frequently turned. The quality of such peat is inferior to machine peat but, in many localities it will supplement the insufficient supply of better fuel.

*This is exclusive of 400,000 h.p. for power possibilities on rivers like the Fraser, Thompson, Skeena and Nass, where, because of the proximity of railways or possible interference with the salmon industry, economical development is, at present, debarred.

Peat has about one half the heat value per pound of best anthracite and its specific gravity is about one half that of anthracite. Therefore, to obtain from peat the same number of heat units as from a specified amount of coal requires about 4 times the volume of peat.

WOOD FUEL

From a fuel standpoint, the principal trees of the Prairie Provinces, east of the Rocky mountains, are, in approximate order of importance, the jackpine, spruce, poplar, tamarack and birch.

In British Columbia and the Rockies, there are numerous fuel woods, most of the wood used as fuel being the refuse from the sawmills. Douglas fir, yellow or bull pine, spruce and cedar furnish most of the wood fuel in this area.

In a discussion by the Forest Products Laboratories, Montreal, of the heat values of dry wood, it is stated that the below amounts of wood have equal heating value to one ton of anthracite:

1.00	cord of	Birch
1.15	cord of	Tamarack
1.20	" "	Douglas fir
1.50	" "	Jackpine
1.55	" "	Poplar
1.60	" "	Hemlock
2.10	* *	Cedar.

The above comparison is based on the supposition that the calorific value of the coal is 13,000 b.t.u. but the grade of coal received in Canada last winter was much less, possibly as low as 10,000 b.t.u. which, in comparison, would decrease the above stated quantities of wood by 23 per cent.

FUEL SHORTAGE

A fuel shortage next winter is highly probable. Dr. Garfield, United States Fuel administrator, states that "an alarming shortage" faces the United States and Canada if the quantities of coal demanded by the various sections of the country are actually required. What will happen if they prove to be conservative statements?

The New England and Atlanctic states will receive increased allotments of anthracite this year, to provide for the increasing concentration of industrial population in these states. Curtailments have been ordered in the Central and Northwestern states and Western Canada.

This year the requirements of Canada and the United States will be 100,000,000 tons greater than last year, whereas there will probably be a deficiency of 50,000,000 tons. To offset this deficiency, we have better quality of coal, conservation and restriction.

It is estimated that the coal mined in the United States last year contained 30,000,000 tons more impurities than in pre-war times, or, that 600,000 carloads were hauled and paid for both as to coal and as to transportation. This is half of the shortage predicted for year.

It is estimated that each per cent of impurity reduced the efficiency of the coal 1.5 per cent more. According to these percentages the American railways did about 75,000.000 tons of useless hauling last year. Effective measures have been taken to avoid the wastes of last year.

The Briquetting of Lignites

By R. A. Ross, M.E.I.C.

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Although the fuel resources of Canada are enormous and varied, their geographical distribution is such as to leave the region between the Atlanctic bituminous coal deposits and the lignite deposits of Saskatchewan destitute of all natural fuels save peat and wood.* Hence the Provinces of Quebec, Ontario and Manitoba must be supplied in large part by importations from the United States, supplemented by shipments from the Eastern and Western Canadian coal areas. High freight rates are an inevitable concomitant of this condition.

As more than half the coal used in Canada is imported from the United States, and as nearly all is used in this naturally coalless region, our dependence upon the United States constitutes at once an industrial menace and a national problem. Fortunately this problem is capable of solution. Superabundant unutilized water powers can provide ample anergy for industrial requirements in Eastern and Central Canada. Farther west the feasibility of meeting requirements in Saskatchewan and Manitoba by utilizing prepared lignites and sub-bituminous coals is the subject of this report.

Throughout the West, and especially in Saskatchewan, the domestic fuel situation is difficult. Either the householder must use the native lignite and sub-bituminous coals of the district, which would be unacceptable to the householder in the East, or he must pay even in normal times, from $10.00 to $15.00 a ton for anthracite coal from Pennsylvania. As a matter of fact, the westerner does use about 500,000 tons of anthracite per year in this district at a cost of about $6,000,000.

In addition to this coal imported for household use, a large amount of native coal is used on account of its cheapness; but as it is dirty, friable, and disintegrates rapidly, it presents no advantage for domestic purposes other than cheapness.

Underlying the province of Saskatchewan are immense deposits of very poor lignites. Better lignites and bituminous coals occur in Alberta. For the utilizing of these fuels in the most effective way for both domestic and commercial purposes, commercial preparation is necessary. For years past, Germany has burned practically no raw coal of any description; the raw product when mined being either briquetted or coked; the by-products together with the resulting fuel being of more economic value to the community than if the coal were burned without recovery processes, as is the practice on this continent.

When the Honorary Advisory Council for Scientific and Industrial Research was formed about a year ago, one of the first problems to attract attention was that of fuel. The situation in the North West in winter time, complicated as it is by stoppages of mines due to strikes, shortages of fuel due to lack of transportation, storms, etc., presented a field for useful work.

A review of the records of the Dominion Mines Branch and various Provincial departments, and of the reports made from time to time by Commissions and individuals both in this country and in the United States, indicated the commercial possibility of transforming the lignites of Saskatchewan into a marketable equivalent of anthracite coal.

Analysis of recorded facts demonstrated that preliminary carbonizing treatment, by which two tons of the raw lignite was converted into one ton of coke and then briquetted under pressure with the aid of a binder, gave better results than any attempt to briquette the raw material itself.

It may be stated in passing that some of the German brown coal can be, and is, briquetted without binding material; but it has been found that this is not possible in the case of the lignites of Saskatchewan and North Dakota. What little pitch they contain has to be supplemented by some effective binder to produce a sound briquette.

During the carbonizing process, the moisture is first driven from the coal, then the gases, and, still later, distillates which yield ammonia, oils, and pitches, all valuable products, so valuable, in fact, that for years past Germany has coked all her coal and saved the distillates and gas.

While these by-products are valuable, their value has not been considered in this respect as it was felt that the quantities which might be recovered would depend upon

*Natural gas and petroleum are relatively of minor commercial importance.

how far it is advisable to lessen the fuel efficiency of the briquetted product.

The Fuel Committee of the Council was fortunate enough to secure the hearty co-operation of the Department of Mines and of the Commission of Conservation, through their Engineers, Mr. Haanel and Mr. Dick, to whom they desire to extend thanks for their efforts.

It was known that the United States Government and certain northern universities had done some work in the way of carbonizing; that briquetting of coal was comparatively common; that the use of binders was fairly well understood; and, in short, that much experimental work had been done, not only in the laboratory, but in a commercial way.

It was found, however, that much of this experimental and investigatory work was rendered inutile because of a marked lack of sequence and articulation. No attempts had been made to co-ordinate complete manufacturing processes for handling such lignites as those of Saskatchewan and North Dakota, these being practically identical in composition.

Investigations were conducted among machinery manufacturers and briquetting plants in operation, to determine the possibility of obtaining adequate machinery. A final report suggesting action was then presented to the Research Council by the Lignites Committee. As this report contains all the details of the project, it is considered desirable to add it to this general statement.

After due consideration by the Council, the report was accepted, and representations were thereupon made to the Government requesting an appropriation of $400,000 to be expended on a plant of about 30,000 tons capacity of briquettes per year; the whole to be handled as a company on a commercial basis during both construction and operation, raw materials being purchased, and the finished product sold with reference only to commercial results, but without profit to the directorate.

It was anticipated that about one year would be necessary to complete the plant, and that thereafter possibly six months would be required for adjusting machinery, experimenting with various binders and mixtures, determining suitable temperatures for distillation under commercial conditions and the quantity of gas and distillates to be driven off.

At the expiry of this period it was expected that the project would be on a commercial basis and that finally the equipment would be operated by the Dominion Government as a producing plant or sold to the Provincial Government or to private individuals, or used as an experiment station for briquetting other fuels.

Briefly, summarizing the report, the financial aspects of the proposition are as follows:

Total capital invested in lands, buildings, machinery, interest and management during construction, etc.	$400,000.00
Cost per ton of briquettes at the mine, including all fixed charges, amounting to 20% on the capital per ton	7.00
Cost of anthracite coal f.o.b. cars Estevan during normal times	$10.00 to $12.00

The above estimates imply that briquettes can be profitably manufactured in Saskatchewan, on a relatively small scale, without taking into consideration the value of by-products, at from $3.00 to $5.00 per ton less than the cost of Pennsylvania anthracite at the same spot.

It may be fairly expected that in the future, with larger plants in operation, profiting by the experience gained in this proposed establishment, briquettes will be produced at a very considerable reduction of the estimates there presented.

This project having been approved by the Research Council, was in June, 1917, presented to the Government with the request for official sanction. After a full consideration of this report the Privy Council recommended on March 20th, 1918, that this project be undertaken by the Government in co-operation with the Governments of the Provinces of Manitoba and Saskatchewan on the conditions that the two Provincial Governments together contribute half of the amount to be expended and that the direction and management of the undertaking be vested in a commission appointed to that end by the three Governments.

Memorandum Concerning Briquetting of Lignites

At the first meeting of Council there was constituted a committee to deal with the utilization of lignites, which committee, added to from time to time, has made interim reports to the Council. It is now possible to make definite recommendations on the sitution.

In the meantime your committee, consisting of: Dr. F. D. Adams, Dr. W. C. Murray, Dr. A. S. Mackenzie, and Mr. R. A. Ross, Convener, has reviewed the general fuel situation throughout the Dominion, and having concluded that the domestic fuel problem of the North West presented the best field for immediate results, thereafter confined its attention to the briquetting of the lignites of the North West for domestic purposes.

Your committee in carrying out this study has availed itself of all the literature and information in the hands of the Dominion Government, and all the public records of the United States Government, relating especially in the latter case to the lignites of North Dakota, and through the good offices of the Mines Branch, and the Commission of Conservation, has had the benefit of the co-operation of Mr. B. F. Haanel and Mr. W. J. Dick.

A considerable amount of literature exists, published chiefly through Government agencies, covering the coal briquetting problem; but there is very little information extant regarding the briquetting of carbonized lignites. Fortunately, however, such information as does exist concerns the lignites of Southern Saskatchewan.

As regards this memorandum, the idea is to present in as concise form as possible the facts and conclusions under suitable heads, placing all statistics and figures in tables at the end.

The Situation

1st. The fuel resources of the Dominion of Canada are second only to those of the United States, the greatest coal country in the world.

2nd. In spite of this fact, Canada imports at present and always has imported—50% of her fuel from the United States. (See Table 3).

3rd. Canadian efficiency in this regard is, therefore, about 50%.

4th. Under these conditions the problem must be attacked, preferably by the Government, and not by isolated commercial agencies working in competition with each other.

5th. An examination of the map attached will show the Canadian territories supplied by coal distributed from various centres and indicate an immense area whose requirements are met from American sources.

6th. The province of Saskatchewan, as will be seen, is the balancing point for fuel from the East and from the West, and for this reason fuel prices are the highest, although underlying a great part of this province are immense deposits of lignite awaiting use.

7th. We, therefore, recommend that the attack on the fuel problem of Canada be concentrated first on the production of domestic fuel from the lignites of Saskatchewan for the following reasons:

(*a*) Because the price of anthracite coal in normal times in this district is the highest and runs about $15.00 per ton.

(*b*) Because successful briquetting of the lignites of Southern Saskatchewan will also solve the problem of briquetting the higher grade lignites of Alberta.

The Lignites

Coals for commercial purposes are arbitrarily grouped as follows: Anthracite, semi-anthracite, bituminous, semi-bituminous, and lignite. All of these are available in this country in greater or less degree.

The manufacture of the lignites into briquettes in the manner proposed constitutes an artificial method of raising a very low grade fuel to the highest grade with the production of gas and other valuable by-products, no allowance for which is made herein.

1st. Various grades of coal, from anthracite in the Rockies to poor lignites in Southern Saskatchewan underlie a large part of the provinces of Alberta and Saskatchewan, whereas farther East we have no coal deposits until the Maritime Provinces are reached.

2nd. The raw lignites of Southern Saskatchewan when taken from the ground contain about 40% of water which must be eliminated by air-drying, or evaporated in the furnace at the expense of the heat value of the fuel.

3rd. This condition renders the raw fuel unsatisfactory for domestic use, both on account of the cost of transporting the water and of its evaporation. The fuel is impure, falls to pieces if stored, and can only be utilized when freshly mined.

4th. An examination of Table 8 will indicate the relative positions of lignite as mined, briquettes of carbonized lignite, and anthracite, in the scale of heating values. When the other factors of operation, such as loss through grates, etc., are considered, it is safe to say that the heating value of the lignite as mined is increased 100% by carbonizing and briquetting.

5th. Raw lignites are briquetted commercially in Germany, but so far it has not been found possible to handle the lignites of North Dakota and Saskatchewan in this way, nor in view of the situation to-day is it advisable to do so even if it were possible.

6th. By carbonizing the lignite a coke or charcoal is obtained which briquettes readily, has a high heat value, and by-products such as tar, ammonium, sulphate, gas, etc., are recovered.

7th. Without consideration of the by-products the result has been to turn two (2) tons of poor fuel into one (1) ton of fuel approximating anthracite in caloric value with practically the same actual heating value in the domestic furnace as the two (2) original tons from which it was made.

8th. After carbonizing, briquetting can only take place through the agency of a binder for which coal-tar pitch and sulphite pitch have been sucessfully used. Sulphite pitch, a waste product from pulp mills, is available in immense quantities. The only purpose which it subserves at the present time is that of poisoning fish in the various waters near which pulp mills are situated.

9th. After carbonizing and briquetting, the fuel must be waterproofed. This is accomplished by a simple heat process resulting in the coking of the binder.

Present State of the Art of Producing Carbonized Lignite Briquettes

The processes involved in the manufacture of carbonized lignite briquettes have all been carried to a stage beyond that of the laboratory. The next step forward involves commercial methods of production on a scale sufficient to demonstrate the best production methods and the costs.

1st. Briquetting of the raw lignites of Central Europe, especially those of Germany, has been carried on successfully for years past, the output for 1913 in Germany being 20,000,000 tons.

2nd. The briquetting of bituminous slacks and small sizes is carried on in several parts of the United States in a commercial way at the present time.

3rd. The briquetting of anthracite slack in British Columbia has been a practical success for some years past, both for domestic and locomotive fuel.

4th. The carbonizing of North Dakota lignites has been carried on at Hebron, N.D., in a semi-commercial way, and carbonized Souris lignite has been produced at Estevan on a small scale.

5th. The briquetting of these lignites, however, has not been carried on in a commercial way, any briquettes made being produced sporadically in carload lots, sufficient in amount only to demonstrate that briquetting is practicable.

6th. Carbonizing is a simple process and sufficient information and experience has been obtained to warrant commercial production.

7th. Briquetting and suitable binders require study upon a commercial scale in order to determine temperatures, pressures, mixtures and results in actual practice.

8th. The necessary waterproofing, which is obtained by a heat treatment of the completed briquettes, presents no difficulty whatever, being a simple matter of coking the binder at a low heat.

9th. Summing up, the producer must face the difficulties inherent in commercial production which are approximately of the same order as those met in other industrial establishments. The problem has been solved; it remains merely to overcome the incidental difficulties.

10th. The road to success in the briquetting problem is strewn with the wrecks of ill conceived attempts to do this apparently simple thing—failure resulting from either lack of knowledge of what had been done, lack of technical experience, or shortage of money.

11th. For the above reasons, amongst others, private capital is chary of such enterprises. It is argued that the chances of failure are great, and, as the market cannot be cornered, any process when successfully developed will be utilized without cost by competitors. The situation in Saskatchewan, therefore, should be grappled by the Government.

12th. Thereafter the business may be continued by the Government as a public utility, or, as demonstration having been made and results shown, private investors may confidently venture.

Equipment Recommended

To carry out on a commercial scale the carbonizing and briquetting of lignites, a considerable amount of equipment is required, and it appears that suitable machinery is obtainable at the present time. In this connection your committee had, through Mr. Haanel, and also individually, the advantage of the advice of mechanical specialists. The following recommendations are submitted:—

1st. By establishing a plant in the Souris coal fields in the neighbourhood of existing mines, the demonstration when made will have covered the treatment of the most difficult material on the American continent, and therefore, success with other and better fuel will be comparatively easy.

2nd. Having passed the laboratory stage, it becomes inadvisable to consider the establishment of a plant of less than 100 tons per day, as the problems involved are not technical so much as commercial, covering such questions as operating temperatures, mixtures, binders, percentages of binders, wages, cost of supplies and repairs.

3rd. We have estimated upon a briquetting press with a capacity of 10 tons per hour, operated 10 hours per day, and producing 100 tons.

4th. We recommend installing one (1) carbonizing oven with a capacity of 2½ tons per hour, operated 24 hours per day, total capacity say 50 tons.

5th. Also a waterproofing plant of a capacity of five (5) tons per hour, for 24 hours, or say 100 tons total capacity.

6th. Also conveying and power plant for 100 tons capacity.

7th. Also complete buildings for covering the 100 ton plant.

8th. By the above arrangement there will be no immediate purchase of the second carbonizing oven which will be necessary to complete the plant, until full commercial tests are made upon the one unit provided.

9th. An inspection of table No. 1 will show that the capital cost of the above with a production of 15,000 tons per year will be $320,000, and yet with this partial equipment all problems may be worked out on a commercial basis.

10th. For the full plant of 30,000 tons per year capacity, an additional carbonizing unit will have to be added. The capital cost of the completed plant as per table No. 1 being $370,000.

11th. From table No. 2, wherein detailed figures are given, it will be seen that the production costs at the plant for carbonized and briquetted fuel, covering operating costs and fixed charges will not exceed per ton $7.00.

12th. An inspection of the figures upon which the results are based will indicate that in every case a most conservative view has been taken. The capital costs are high, labor is allowed for with liberality, percentages for depreciation, repairs, etc., are high and the costs of materials also. As a matter of fact, the estimated costs herein given are much in excess of those put forward in any other estimate of which we are aware. It can, therefore, safely be predicted that no probable combination of prices could exceed the aggregation here given.

Commercial Conditions

Having dealt with the technical aspects of carbonizing and briquetting, it is now appropriate to discuss the handling and marketing of the finished product. This involves commercial handling which is equally important as production. As notes on the above remarks, the following are presented:—

1st. The plant in contemplation will be constructed as a unit to which other units of similar size can be added, or established elsewhere. A similar plant of this size would not supply more than a local market. If constructed at Estevan for example, it would have its market only in Regina, Moose Jaw, and the intervening country, as the tonnage of 30,000 per year of domestic fuel would only supply the requirements of a population of 20,000 people.

2nd. Assuming a cost of $7.00 per ton at the plant, and a transportation cost of $1.50 to Moose Jaw, with a dealer's profit and delivery cost of $1.50, the total price to the consumer at Moose Jaw would not exceed $10.00 per ton. It would be less at Regina, and still less in the intervening country districts where it would not be sold to a dealer or delivered by him, but would be unloaded by the farmers from their own cars. This price at Moose Jaw, however, under the worst conditions would be two to five dollars less per ton than present prices paid.

3rd. While the present costs of coal have been referred to above, it must not be supposed that these will continue, for recent past records indicate an increased

cost of 50 cents per ton per year. As a matter of fact, the rate of increase may be expected to be considerably higher than this, leading eventually to the elimination of anthracite altogether on the score of price, with the imminent prospect of an embargo being placed on the export of this coal from the United States in the not distant future. In short, the costs of anthracite must go up, and the costs of briquettes will go down with larger production, and the spread, therefore, becomes continually greater.

4th. Using present figures for one year's operation, the annual saving of a minimum of $2.00 per ton to the people of this district would total $60,000.

5th. Even if no saving were made, and the selling costs of briquettes were as high as that of anthracite coal at present, there would be kept in the country the sum of $360,000 per year.

Procedure

If the suggestions made be considered adequate to establish the advisability of the construction of such a plant as is indicated herein, other questions will immediately arise which should be looked at in advance.

1st. Contracts will have to be entered into for all kinds of machinery without restriction as to where it is produced or by whom it is produced, but considering only its demonstrated suitability for the work in hand.

2nd. The question of the site of the plant will have to be decided upon with a view not only to proximity of supplies, but also of alternative supplies from whatever mines are available, or, possibly, from a Government-owned mine, which should be situated as closely as possible to the site of the plant, thus providing a supply in case of trouble with other mines.

3rd. Contracts will have to be entered into with an existing mine or mines for such material as the waste fines. In this connection it may be stated that usually the mines only operate in winter when lignite is used, as it cannot be stored, whereas a briquetting plant would purchase all the year round and use what is now practically waste material.

4th. A staff will have to be appointed consisting of manager or superintendent, chemist, etc., on the basis of fitness for this particular class of work, as the character of the work implies a certain degree of special training.

5th. Arrangements will have to be made with dealers or otherwise for the distribution of fuel in competition with coal. With a small plant such as here indicated there should be little trouble with this aspect of the case,while the product would be of sufficient volume to give a demonstration of commercial costs.

6th. An office system will have to be installed by means of which accurate costs of raw materials entering into the product, the labour costs and the tonnage output costs may be found, and the whole lead up to something that might be presented to the Government in a general report covering results.

7th. A review of the above activities does not indicate that they are such as could best be carried out under Departmental control. The whole project is a commercial one, which will have no justification for its existence if it does not give commercial results, and this involves commercial handling. It is imperative, therefore, that the construction and operation of this plant be placed in the hands of a Board constituted of technical and business men whose hands are not tied in any way.

Summing Up

In view of the discursive nature of this report a summing up may be advisable.

1st. The necessity exists for the development of all our fuel resources.

2nd. The best immediate returns will be secured by the development of lignite briquetting processes.

3rd. The country has the raw materials, the brains and the command of money for such national work.

4th. Leaving the problem in private hands will result in long delays during which we must buy our fuel abroad.

5th. In view of the broad national importance of the field the actual capital necessary is of secondary importance only.

6th. Full success will mean the stoppage of millions of outgo to the United States and its expenditure in wages in Canada.

7th. If only a partial success be secured a step shall have been taken in a problem which must be solved ultimately.

8th. A complete failure is unthinkable, but granted that outcome, the money if judiciously spent will have demonstrated the uselessness of further trials, and will lay a ghost which otherwise will be continually in evidence.

Action

If this report be found convincing and be adopted by the Council prompt action will be necessary as the season is advancing.

It is estimated that a year will be required to construct and equip the plant, owing to existing conditions in Canada and the United States.

Further, a period of six months may elapse before the plant in operation will have so adjusted its processes as to turn out a uniform product at a commercial cost.

In order, therefore, that the plant should be in operation by this time next year and delivering its output by the winter of 1919, the buildings must be erected during the coming summer or within a period of six months. During the ensuing winter the machinery may be installed.

Within the next six months therefore, the Government's approval must be given, a Board constituted, a manager appointed, plans made and contracts let for equipment, and the buildings designed. For these buildings contracts must be let and construction completed before December next. Any failure in this programme means the loss of a year.

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Saskatchewan Branch.

Canadian Engineering Standards Committee

Quietly and unostentatiously there was recently created in Montreal an organization at present known as the Canadian Engineering Standards Committee under the chairmanship of Sir John Kennedy, the influence of which in the years to come is bound to be felt in Canadian industrial life. In fact, the extent to which the work which this committee has set out to accomplish in standardizing engineering practice in its industrial application becomes effective and is adopted by Canadian manufacturers will largely determine the part Canada is to play in the future as an exporter of manufactured products.

Engineering standardization is now generally recognized as of paramount importance to economic production. Its primary objects are to secure interchangeability of parts, to cheapen manufacture by the elimination of waste entailed in producing a multiplicity of designs for one and the same purpose, to effect improvement in workmanship and design and by concentration rather than by diffusion of effort to expedite delivery and reduce maintenance charges and storage.

The Canadian government has officially endorsed the establishment of this committee, and has appointed as its nominees, Lt. Col. W. P. Anderson, C.M.G., M.E.I.C., chief engineer, department of Marine, Ottawa, representing the department of Marine; Dr. E. Deville, surveyor general, representing the department of the Interior; Dr. A. B. Macallum F.R.S., chairman of the Honorary Advisory Council for scientific and industrial research, representing the Advisory Council; Lt. Col. C. N. Monsarrat, M.E.I.C., consulting engineer, department of Railways and Canals, Ottawa, representing department of Railways and Canals; Capt. R. J. Durley, M.B.E., M.E.I.C., representing the Imperial Ministry of Munitions, Ottawa; Major W. J. Keightley, chief inspector of military stores, Ottawa, representing the department of Militia; E. O. Way, chief inspector, weights and measures, Ottawa, representing the department of Inland Revenue; K. M. Cameron, M.E.I.C., supervising engineer, department of Public Works, Ottawa, representing the department of Public Works. The Canadian Manufacturers Association is represented by William Inglis, John Inglis Company Ltd., Toronto, and P. L. Miller, general manager: Canadian Vickers Limited, Montreal. The Advisory Council for Scientific and Industrial Research is further represented by Robert Hobson, president: Steel Company of Canada, Hamilton, Prof. J. C. McLennan, F.R.S., University of Toronto, Toronto, R. A. Ross, M.E.I.C., city commissioner, Montreal, consulting electrical engineer, Dr. R. F. Ruttan, McGill University, Arthur Surveyer, M.E.I.C., consulting engineer, Montreal. The Institution of Civil Engineers of Great Britain at whose urgent request this committee was established and which fathered the movement for the establishment of the British Engineering Standards Committee, the work of which has had a wonderful effect on British industry, is represented by Sir John Kennedy, Hon. M.E.I.C., W. F. Tye, M.E.I.C., consulting engineer, Montreal, H. H. Vaughan, President, Engineering Institute of Canada, general manager, Dominion Bridge Company, Ltd., Montreal and Dr. John Bonsall Porter, M.E.I.C., professor of mining engineering, McGill University; The Engineering Institute of Canada is represented by G. H. Duggan, M.E.I.C., managing director, Dominion Bridge Co., Ltd., Montreal, and Dr. L. A. Herdt, M.E.I.C., professor of electrical engineering, McGill University. The Canadian Mining Institute is represented by Dr. Alfred Stansfield, professor of metallurgy, McGill University and F. H. Crockard, Pres. Nova Scotia Steel & Coal Company, both of whom are members of The Engineering Institute of Canada. Of the 24 members of the committee 14 are members of The Engineering Institute.

At the organization meeting Sir John Kennedy, the dean of the engineering profession in Canada, to whom the formation of this committee was suggested by the late Sir John Wolfe Barry, was unanimously appointed chairman and H. H. Vaughan and Capt. R. J. Durley, vice-chairmen. Dr. John Bonsall Porter was elected honorary secretary-treasurer and Fraser S. Keith, secretary. The headquarters of the organization will be at The Engineering Institute building, 176 Mansfield St., Montreal.

At the urgent request of the British committee, sub-committees on screw thread and aeroplane parts were created under the chairmanship of H. H. Vaughan and Capt. Durley respectively. It is intended that other sub-committees shall be appointed as required, choosing the best men available in Canada to effect this work.

The British Engineering Standards Committee which works in conjunction with the Board of Trade, from which the present committee has been patterned, is representative of the whole engineering industry of Great Britain and is competent to examine all proposals for improvement, to assimilate the best out of them all, and, as a result to recommend standards, based on a sure and strong foundation, upon which new developments and improvements can be built. From its inception some 16 years ago, the committee in carrying out its work has been guided by a recognition of the community of interest of producer and user.

The splendid results obtained by the British committee has shown the enormous value of standardization to production and suggested the formation of similar committees in the British Dominion leading to the general standardization of engineering practice in the Empire. There is a further field, however, and a wider aim and object, for the British committees are preparing to co-operate with the Engineering Standards Committee of the United States, just established under the approval of the great engineering organizations in that country. Because of the wide difference in some of the methods in engineering practice between Great Britain and the United States, the work of the Canadian committee will have an important bearing in harmonizing these differences.

The ultimate work of these committees will tend to give effect to the industrial supremacy of the English speaking nations of the world.

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Western Professional Meeting

In this issue of the Journal will be found a complete programme of the Second Professional Meeting of the Institute, to be held at Saskatoon, August 8th, 9th, 10th, for the organizing of which the Western Branches deserve great credit. It is the most ambitious programme that has yet been attempted at any technical meeting in Canada and bears not only upon the engineering problems of the West, but upon the relations of our organization to its members and the development of the Institute itself.

Thanks to the courtesy of Dr. W. Murray, President of the University of Saskatchewan, the meetings will be held in the University buildings where the visiting members will enjoy a supper on Thursday evening and a dinner Friday noon. Apart from interesting excursions planned for Saturday afternoon, August 10th, the programme has been divided in five sessions, commencing at 3 p. m. Thursday.

Included is a banquet on Friday evening when those in attendance will be entertained by the city of Saskatoon.

The first session will be devoted entirely to Good Roads, the papers on which besides those of a specific nature, deal also with the experience of the Western Provinces in road building and will also inform us of their policy regarding highway legislation. The second session, Water Supply and Sanitation, on Thursday evening, deals with what is of great importance to the Prairie Provinces at the present time and more particularly in regard to future development. On Friday morning at 9.30, the third session will commence, being devoted to the subject of Concrete, which apparently involves problems owing to the alkaline nature of the soils which have not been encountered in other parts of Canada, and which must be solved by the engineer. Fuels will receive complete attention on the fourth session on Friday afternoon. At a time when the fuel situation in the West is acute a means must be developed for its relief, consequently it becomes an engineering problem, and this session affords an opportunity of an exhaustive discussion. While it would be unfair to discriminate as between the importance of the various sessions, the fifth designed for discussion of professional and Institute affairs, is not secondary. Apart from annual meetings of the Institute this is the first time that this subject has been given the attention that it warrants and the suggestions arising from the papers and discussion, will doubtless give a sense of direction, at least, to the future of the Institute.

The committee in charge of arrangements has given attention to every detail and besides planning for visits on Thursday forenoon and Saturday afternoon, a ladies' committee will look after those fortunate enough to be accompanied by their wives or daughters.

The Engineering Index

As a result of negotiations entered into between President Vaughan of the Institute and Secretary Rice of the American Society of Mechanical Engineers, arrangements have been concluded whereby we are enabled to publish each month in the Journal the Engineering Index prepared by the staff of the American Society of Mechanical Engineers. In a letter from Mr. L. G. French, editor of the Journal of the American Society of Mechanical Engineers, he gives information which shows the spendid organization possessed by the American Society of Mechanical Engineers for the preparation of this index. In part he states:—

"We regularly receive in the Library in this building, all the engineering periodicals of the world numbering, in normal times, over 1100. For seven years we have regularly reviewed these periodicals in The Journal, both foreign and American, and now by unanimous vote of the Publication Committee we are to add the feature of a selective index of titles of articles which will be prepared with the greatest care by engineers who have been trained in this kind of work. Each reference to an article will contain a brief descriptive sentence explaining its character, a feature which can only be undertaken where engineers are employed for indexing.

As to our personnel, the work will be in charge of Mr. Leon Cammen, who is most accomplished and has conducted our Review Department since its inception. Our Associate Editor, Mr. C. M. Sames, will cooperate with him. Mr. Sames for six years edited the Technical Press Index in Engineering Digest (now out of existence), which was similar in scope to the Engineering Index of the Engineering Magazine (now Industrial Management), and was Professor Marks' right-hand man in getting our Marks' Mechanical Engineers Pocket Book.

Further assistance, amounting to about half his time, will be given by Mr. George A. Stetson of Sheffield Scientific School, New Haven, Conn., under the direction of Professor L. P. Breckenridge who, as you know, has for years made a hobby of indexing periodicals and when at the head of the department of the University of Illinois, issued a pamphlet on the Extension of the Dewey System to Engineering Literature. A fourth person to participate in the work is Professor J. L. Vera who has recently come to us from the head of the physics department of Notre Dame University of Indiana, a graduate engineer in both mechanical and electrical engineering.

These men are all specialists and will give so much of their time as may be necessary to review the periodicals in the fields with which they are familiar, and will personally prepare the index cards.

You will see from this that the Publication Committee of our Society has laid very broad plans for doing a valuable piece of work, and doing it well. As a matter of course, the growth of the index will be gradual, increasing in amount from month to month as the work becomes systemized.

We understand that Mr. Keith is to visit the Society in the near future, and we would like to have him go into the matter in as great detail as he may care to.

The Institute is fortunate in the result of the arrangements mentioned above and it further illustrates the splendid spirit prevailing between the national organization of Canada and the Founder Societies of the United States.

Hamilton Branch

Proceeds with Organization

The routine work in connection with the formation of a Hamilton Branch of the Engineering Institute of Canada was advanced another stage at a meeting of local engineers at the Royal Connaught Hotel. The splendid attendance, in spite of the intense heat, indicates the deep interest taken in the organization.

Three strong committees were appointed,—a nominating committee which is to arrange at once for a letter ballot for the election of permanent officers, a by-law committee which is intrusted with the drafting of by-laws, and a membership committee which will endeavor to get in touch with every engineer in this district. The following is the personnel of the committees.

Nominating:—H. E. Janney, chairman, R. L. Latham, J. A. MacFarlane, E. H. Darling and John Taylor.

By-laws:—E. H. Darling, chairman, H. V. Hart, F. W. Paulin, W. D. Black and J. Erskine.

Membership:—E. R. Gray, chairman, C. F. Whitton, H. E. Janney, H. B. Dwight, M. A. Kemp, W. B. Ford, J. G. Jack, E. H. Pacy.

Personals

Lieut. D. G. McLean, S.E.I.C., R.F.C., has been officially reported killed in action in Italy on February 4th, 1918.

* * *

Kenneth S. Pickark of the Imperial Ministry of Munitions received a commission in the Canadian Railway Troops and left for overseas service towards the end of July.

* * *

Captain Gregory, M.C., Alive and Well

During 1917 the Secretary's office was advised that Alexander Watson Gregory had been killed in action on April 9th, 1917, and consequently the Roll of Honour of the Report of the Annual Meeting contains a notice to that effect. It will be pleasant news to all of his friends in Canada to know that this gallant son of New Brunswick is not only hale and hearty, but that he has recently been appointed to a captaincy and has been awarded the military cross for perspicacity in bringing up supplies, etc. under exasperating circumstances. In a letter containing this information, A. G. Tapley, A.M.E.I.C., of St. John, stated that Captain Gregory is now Transport Officer with the 26th Battalion and that this information is undoubtedly authentic as one of Mr. Tapley's correspondents is a brother officer of Capt. Gregory in the same unit.

Correspondence

Conscription and the Engineer

I cannot pass the June issue of the Journal without an expression of appreciation for the editorial "Conscription and the Engineer".

This is a very clear and forcible exposition of the need for reform in public policy. It also suggests the possible remedy, which might be termed "Organized Activity". It is only too true that "Individually we effervesce and boil but collectively we are inactive and supine".

In a time when every red-blooded man is anxious to do his utmost to assist in solving the great problems which are constantly arising, it is a sad sight to see the engineer, economist and administrator by education and profession, unable to put his talent at the disposal of the public on account of ancient usages of public policy.

It is to be hoped that some of those who read that editorial may not allow its inspiration to be dissipated without some thought and action, remembering that we have an organization through which all may contribute to a common cause.

I am,

Very sincerely yours,

(Sgd.) M. W. PLUMB.

Report of Council Meeting

Report of Committee on Legislation. Claim for exemption from taxes. Leonard Medal Regulations. Ontario Provincial Division. New Certificates. Drainage Commission Suggestions. Identification Cards. Elections and Transfers.

The regular monthly meeting of the Council was held at the headquarters of the Institute on Tuesday evening, July 23rd.

Legislation Committee Report: The report of the Committee on Legislation regarding provincial legislation was presented in a letter from the Chairman of the Committee, Mr. Surveyer. After a lengthly discussion it was resolved that this report be sent to all councillors, with the request that each member send in a discussion thereon to be considered at a future meeting.

Exemption from Taxes: A suggestion from the Legislation Committee that the Institute retain Mr. Aimé Geoffrion, K.C., instructing him to bring a plea before the Recorders Court, regarding exemption from taxes, was presented and approved.

Leonard Medal Regulations: The revised Leonard Medal regulations were approved.

Ontario Provincial Division: The Secretary announced that a sufficient number of requests had been received to sanction the approval of a Provincial Division in Ontario and consequently approval was given for the establishment of a provincial division in Ontario, the Secretary being instructed to notify the branches.

The Executive Committee had met once since the last meeting of Council and reported and recommended as follows:

New Certificates: After discussion, on motion by J. M. R. Fairbairn, seconded by A. E. Doucet, a committee consisting of H. R. Safford, Walter J. Francis and Ernest Brown, was appointed to look thoroughly into the question of a new certificate and report to Council, with the request that this committee also report on the perpetuation of the former name and also on the issuance of an identification card.

Drainage Commission's Suggestions: That the names submitted by the Executive of the Manitoba Branch to the Provincial Government for consideration in the appointment of a chairman of the Drainage Commission, be approved. Approved.

Co-operation with the Canadian Mining Institute: That the Secretary write the Secretary of the Canadian Mining Institute in reference to a request for co-operation in urging the authorities to introduce measures for educational reform along the lines suggested by C. V. Corless, advising that the Institute was heartily in sympathy with this movement, but suggesting that, in view of the recent announcement of the Canadian Government, it had already under consideration the question of adopting the policy already urged. Approved.

Identification Cards: That Council approve of the issuance of an identification card for Members, Associate Members, Juniors, Students and Associates of the Institute, to be sent out when dues are paid. Approved.

That W. F. Tye be chairman of the committee appointed to co-operate with the American Society of Civil Engineers. Approved.

Programme for Halifax Meeting: That the programme submitted by F. A. Bowman be approved for the dates of the 11th, 12th and 13th of September. Approved.

A number of letters were presented dealing with various matters, all of which were noted by Council. Mr. R. F. Hayward was appointed chairman of the Investigation Committee of British Columbia.

Classifications were made for a ballot to be opened at the next meeting of Council.

A ballot was canvassed and the following declared elected:

Members: William Stewart Ayars, of Halifax, N.S., Principal of re-education under the Military Hospitals Commission and President of the Nova Scotia Society of Engineers. Lionel Clan Charlesworth, of Edmonton, Alta., Deputy Minister and Chief Engineer, Department of Public Works, Alberta. Abraham Halford, of Toronto, Ont. with the Ontario Dept. of Public Works since 1906; has been chief engineer since 1911. Charles Harvey Wright, of Halifax, N.S. Has been with the Canadian General Electric Co. since 1896; at the present time he is district manager and engineer.

Associate Members: Robert Brunton, of Victoria, B.C., at the present time, commissioned officer, Intelligence Staff, Military District No. 11, Victoria, B.C. Previously engaged by the C. N. Railway. A. H. Corbett, of Winnipeg, with the Manitoba provincial Government in charge of general municipal drainage and road work from Dauphin to the Pas. William Edgar Davis, of Winnipeg, Major O.C. 11th Bn. Canadian Railway Troops, France. Previous to enlistment, member of firm of Davis & Barienbrock, Railway contractors. Arthur Frederick Dyer, of Halifax, N.S., at the present time in charge of construction and general consulting work for Furness Withy & Co. Joseph Wesley Hackner, of Toronto, Ont., Asst. engineer with the Dept. of Public Works, Ontario, in charge of inspection, construction and general survey work. Charles Hayward, of Sault Ste. Marie, Ont., with the Algoma Construction and Engineering Co., Ltd. Herbert Horsfall, Leaside, Ont., works manager of the Canada Wire & Cable Co., Leaside Munitions Co., Toronto, and of the St. Catharines Steel & Metal Co., St. Catharines. Robert Mackay, of Calgary, Alta., since 1910, superintendent and electrical inspector for the City of Calgary. Charters Gordon Mackenzie, of Moose Jaw, Sask. Since 1911, assistant engineer, Bridge Department of the Canadian Northern Railway. John McHugh, of New Westminster, B.C., resident engineer of the Department of Naval Service, Fisheries Branch, New Westminster. Edward George O'Kelley, assistant engineer of the Public Works of Canada, Toronto, in charge of design, construction and drawing up specifications for timber crib work. George Wyon Rogers, of St. James, Man., engineer to the Municipality of Assiniboia since 1911. John Henry Walshaw, of Calgary, Alta., building inspector for the City of Calgary.

Juniors: John Arthur Dickinson, of Hawkesbury, Ont., mill building design, survey work and general mechanical details for the Riordon Pulp & Paper Co., Ltd. J. M. Gordon, of Toronto, paving superintendent with the Warren Paving Co., in full charge of bitulithic paving construction in Port Arthur, Fort William, St. John, N.B., New Glasgow, Halifax and Moncton. Cecil R. Scott, of Toronto, designing for the firm of James, Loudon & Hertzberg.

Transfers: Junior to associate member: Robert William Ross, of Melville, Sask., with the Grand Trunk Pacific Railway since 1906. At the present time he is instrumentman on maintenance.

Students to Juniors: Henri Bertrand, of Montreal, since May, 1917, in charge of lining of Grand Trunk Railway through the White Mountains. Ernest Frank Browne, of Ottawa, Ont. a corporal in the Engineering Field Co., C.E.F. France, since 1915. William Kerr Creatrex, of Toronto, chief examiner for the Imperial Ministry of Munitions. Robert Chesley McCully, of Winnipeg, in charge of construction for the Imperial Oil Company.

Preliminary Notice of Application for Admission and for Transfer

2nd August, 1918.

The By-Laws now provide that the Council of the Society shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to Secretary any facts which may affect the classification and election of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described on 27th August, 1918.

FRASER S. KEITH, Secretary.

*The professional requirements are as follows:—

Every candidate for election as MEMBER must be at least thirty years of age, and must have been engaged in some branch of engineering for at least twelve years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in some school of engineering recognized by the Council. The term of twelve years may, at the discretion of the Council, be reduced to ten years in the case of a candidate who has graduated in an engineering course. In every case the candidate must have had responsible charge of work for at least five years, and this not merely as a skilled workman, but as an engineer qualified to design and direct engineering works.

Every candidate for election as an ASSOCIATE MEMBER must be at least twenty-five years of age, and must have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineers' office, or a term of instruction in some school of engineering recognized by the Council. In every case the candidate must have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years.

Every candidate who is not a graduate of some school of engineering recognized by the Council, shall be required to pass an examination before a Board of Examiners appointed by the Council, on the theory and practice of engineering, and especially in one of the following branches at his option Railway, Municipal, Hydraulic, Mechanical, Mining, or Electrical Engineering.

This examination may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five years or more years.

Every candidate for election as JUNIOR shall be at least twenty-one years of age, and must have been engaged in some branch of engineering for at least four years. This period may be reduced to one year, at the discretion of the Council, if the candidate is a graduate of some school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-five years

Every candidate who is not a graduate of some school of engineering recognized by the Council, or has not passed the examinations of the first year in such a course, shall be required to pass an examination in the following subjects Geography, History (that of Canada in particular), Arithmetic, Geometry Euclid (Books I.-IV. and VI.), Trigonometry, Algebra up to and including quadratic equations.

Every candidate for election as ASSOCIATE shall be one who by his pursuits, scientific acquirements, or practical experience is qualified to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as references does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

ARMSTRONG—HARRY WESTROPP, of Toronto, Ont. (On active service.) Born at Cobourg, Ont., Dec. 15th, 1887. Educ. Collegiate Inst.; 1903-4, rodman, Lindsay Branch, C.P.R.; 1904-5, inst'man, upper Ottawa River survey, Dom. Govt.; 1905-6, leveller, transitman and acting ch. of party, N. T. Ry.; 1906-8, res. engr., C.P.R.; 1908-9, maintenance of way same concern; 1909-11, res. engr., C.N.O. Ry.; 1911-13, divn. engr. same concern; 1914-15, engr. of bridges, Toronto-Hamilton Highway Commission; 1915 to date, on active service; 17 mos. Can. Machine Gun Corps; 18 mos. Can. Rly. Tps.

References: A. F. Stewart, A. L. Hertzberg, R. L. Latham, H. S. Van Scoyoc, H. W. D. Armstrong.

BOYLE—ANDREW JOSEPH, of Edmonton, Alta. Born at Antigonish, N.S., Nov. 28th, 1886. Educ. St. F. X. Univ., Antigonish; 1906-11, (summers), rodman and inst'man, Transcontinental Ry.; with C. N. Ry. as follows:—1911, (7 mos.), levelman; 1912, (4 mos), transitman; 1912-13, res. engr.; 1913-14, engineering inspector on stations, tanks, etc.; 1915, (7 mos), res. engr.; 1915-16, transitman on location; 1916-17, res. engr.; 1914-15, res. engr., Winnipeg Electric Ry.; 1917 to date; asst. engr. Dept. of Railways and Canals, in chg. of locating party.

References: A. Ferguson, W. Burns, T. Turnbull, A. T. Fraser, M. Wolff.

BROWN—GEORGE BASIL, of Halifax, N.S. Born at Montreal, Que., Nov. 28th, 1896. Educ. R.M.C. 1915-16; summer 1916, on hydro electric installation; at the present time, Lieutenant R.C.E., officer in chg. of Defence Electric Light Detachment, Halifax, N.S.

References: L. G. Van Tuyl, J. F. Pringle, T. S. Scott, J. L. Allan.

DAVIES—GEORGE VICTOR, of Quebec, Que. Born at Liverpool, Eng., June 21st, 1887. Educ. Liverpool Tech. School and Liverpool Univ.; 1903-10, detailing estimating and designing with Francis Morton & Co.; 1910-12, in chg. of design and erection of work with Redpath Brown & Co., Manchester; 1912-13, designing with Cleveland Bridge Co.; 1913-18, asst. engr., St. Lawrence Bridge Co., Quebec.

References: G. F. Porter, G. H. Duggan, E. C. Kerrigan, A. L. Harkness, R. Henham, L. G. Jost.

FARLEY—ARLO VIVIAN, of Hamilton, Ont. Born at Hamilton, Ont., Feb. 22nd, 1891. Educ. High School; 1913-14, railway bridge work Welland Canal; 1914, with T. C. Ry.; 1914-15, with Can. Govt. Rys., Nova Scotia; 1915-16, Kingston Harbour; 1916-17, asst. to res. engr., Hamilton Bridge Works Co.; at the present time, asst. engr., Wilputte Coke Oven Corporation.

References: W. E. Janney, J. A. McFarlane, J. G. Jack, T. T. Black, F. R. Adelhem.

LEAVER—CHARLES BURFOOT, of Dartmouth, N.S. Born at Toronto, Ont., Dec. 27th, 1889. Educ. B.A.Sc. Toronto Univ. 1910; drafting, automobile factory; lamp testing, National Electric Lamp Association, Cleveland; 1912-15, designing and laying out refinery constrn., Imperial Oil Limited; 1915 to date, asst. supt. Dartmouth Refinery, in chg. of constrn. and operation.

References: E. F. T. Handy, R. H. Smith, F. A. Bowman, C. E. W. Dodwell.

MacKAY—WILLIAM BLAIN, of Halifax, N.S. Born at Seaforth, Ont., Sept. 9th, 1885. Educ. Toronto Tech. School; apprenticeship with Robb Eng'g. Co., and Gurney Foundry Co.; 8½ yrs. ch. dfsman and heating engr., Gurney Foundry Co.; 5 yrs. member of firm Farquhar Bros. Ltd., Halifax.

References: F. A. Bowman, D. Barry, J. W. G. Campbell, J. F. Pringle, L. J. Van Tuyl.

McCOLOUGH—REGINALD WALKER, of Halifax, N.S. Born at Dartmouth, N.S., Oct. 24th, 1887. Educ. S.B., Nova Scotia Tech. Coll.; dftsman, Halifax & Eastern Ry.; instructor in surveying N.S. Tech. Coll.; instrument work, Dom. Govt. hydraulic surveys; res. engr., Can. Govt. Rys., Dartmouth to Deans Branch; private land surveys in N.S.; hydraulic surveys for Renfrew Mining Co., Renfrew, N.S.; at the present time, 3rd division officer, R.C.E., Halifax, N.S.

References: W. A. Hendry, L. H. Wheaton, J. L. Allan, J. F. Pringle, D. Barry.

McKENZIE—REGINALD JAMES, of Deacon, Man. Born at Hamilton, Ont., Sept. 25th, 1889. Educ. Univ. of Toronto; 1911, (4 mos), rodman Dom. Govt. Irrigation Dept., Maple Creek, Sask.; 1912, (2 mos), rodman with Duff & Edwards, Lethbridge, Alta.; with Kettle Valley Rly. Co., as follows:—1912-13, inst'man on constrn; 1913, (6 mos), res. engr. on constrn.; 1913-14, dftsman; 1914, transitman on location; 1914-16, dftsman; with G. W. W. D. as follows:—1917-18, senior inspector; at the present time, office engr.

References: A. McCulloch, H. N. Gahan, W. G. Chace, J. Armstrong, D. L. McLean, D. N. Sharpe.

MISENER—JOHN S., of Dartmouth, N.S. Born at Boston, Mass., Apr. 10th, 1873. Educ. Correspondence Schools; 20 years, ch. engr., Acadia Sugar Refining Co., Halifax, N.S.; at the present time, ch. engr. and asst. mgr. same firm.

References: J. L. Allan, F. A. Bowman, P. A. Freeman, W. A. Hendry, E. F. Handy.

MONTAGUE—JOHN RUSSELL, of Montreal, Que. Born at Niagara Falls, Ont., Mar. 25th, 1891. Educ. B.A.Sc., Univ. of Tor.; 1909, (4 mos), recorder on Stadia survey of Niagara River, with Ontario Power Co. as follows:—1909-10, rodman; 1910, inst'man; 1911, in chg. of field party; with A. R. Henry, Montreal, as follows:—1913, asst. to res. engr.; 1914-16, res. and designing engr. on constrn.; 1916, (4 mos), office mgr., Robt. W. Hunt Co., Montreal; 1916-18, supt. of constrn. Raymond Concrete Pile Co.; at the present time, designer and res. engr., with A. R. Henry.

References: A. R. Henry, G. R. Heckle, T. H. Hogg, E. A. Wallberg, J. Ruddick.

PALMER—ROLAND FOSTER of Winnipeg, Man. Born at London, Eng., Feb. 27th, 1888. Educ. Manchester School of Tech.; 1904-7, apprenticed to Sir William Collingwood; 1910, tutoring in Marine Engineering; 1911, in field and office, Allan Findlay, Winnipeg; 1912-13, drftsman, calculator and signal dftsman, C.P.R.; 1915 to date, member of firm Palmer & Hobson.

References: J. A. Hesketh, A. R. Ketterson, E. E. Brydone-Jack.

ROME—ROBERT, of Vancouver, B.C. Born at Kilmarnock, Scotland, Nov. 9th, 1883. Educ. Kilmarnock Academy & Royal Tech. Coll., Glasgow; 1899-1904, pupilage with P. C. Hart, Glasgow; 1904-5, asst. to above; 1905-7, res. engr. for R. C. Farrell, Glasgow; 1907-10, res. engr. and local mgr., A. Waddell & Son; 1910-11, with G.T. Ry. on masonry design for Toronto Grade Separation Scheme; 1911-12, on development work C.P. Ry., Vancouver; 1912-14, City Engineer's staff, Vancouver; 1914 to date, asst. to A. D. Creer, City Engineer, Vancouver.

References: A. D. Creer, A. G. Dalzell, R. S. Lea, W. H. Powell, R. F. Hayward, J. R. W. Ambrose, W. B. Greig.

ROWLANDS—JOHN FREDERICK, of Kelowna, B.C.. Born at Wrexham Eng., Oct. 29th, 1885. Educ. Beaumaris Grammar School; 1904-6, articled pupil to G. Riley, Wellington, Eng.; with Egyptian Govt. as follows:—1907, (8 mos), dftsman and junior asst. to ch. engr.; 1907-8, field surveys, levelling etc.; 1909-10, res. engr.; with Provincial Govt. of B. C. as follows:—1911, assisting W. R. Pilsworth on hydrographic surveys; 1912-14, in chg. of water rights investigations and surveys; 1915, reporting on irrigation works, etc.; 1916-17, in Can. Exped. Force; at the present time, field engr. B. C. Govt., Water Rights Br., Lands Dept.

References: W. Young, E. Davis, E. G. Marriott, W. R. Pilsworth, F. W. Groves, H. A. Icke, W. J. E. Biker, F. W. Knewstubb.

RUSSELL—HAROLD ALLISON, of Dartmouth, N.S. Born at Dartmouth, Dec. 11th, 1873; student asst. on surveys, Dom. Govt. Rys.; with Public Works Dept., Halifax, as follows:—1900-9, asst. engr.; 1909-12, dist. engr.; 1912 to date, contracting, Russell & McAulay.

References: W. P. Morrison, W. G. Yorston, C. E. W. Dodwell, E. D. Lafleur, J. L. Allan.

RYAN—EDWARD A., of Westmount, Que. Born at Montreal, Que., Jan. 1st, 1890. Educ. B.Sc. McGill Univ.; summer 1908, dftsman and asst., City of Westmount; summer 1910 and 1911, testing electrical equipment, M. L. H. & P. Co.; 1912-15, dftsman, asst. engr. and engr. in chg. of electrical equipment, Ross & Macdonald; 1915 to date, with R. J. Durley, general consulting work.

References: R. J. Durley, E. J. Turley, J. W. McMahon, L. A. Herdt, J. S. Cameron.

STAIRS—JAMES ALFRED, of Wayne, Mich. Born at Dartmouth, N.S., Dec. 21st, 1876. Educ. R. M. C.; 5 yrs. dftsman and ch. dftsman, Carnegie Steel Co., Pittsburg, Pa. and Lackawanna Steel Co., Buffalo; 5 yrs. asst. supt. and supt., Nova Scotia Steel & Coal Co.; 1909-17, Vice-Pres. and supt., Brown Machine Co., New Glasgow; night supt., Duquesne Steel Works; supt. of constrn., Albion Colliery; supt. of erection of structural steel, Acadia Sugar Refinery; supt. on constrn. limestone quarry conveying and limestone stocking plant for Dom. Iron & Steel Co. in Newfoundland; supt. of shops for Eastern Steel Co. and Albion Machine Co.; at the present time, genl. supt. ordnance dept., Harroun Motors Cor., Wayne, Mich.

References: R. E. Chambers, D. McD. Campbell, W. G. Yorston, R. McColl, D. H. McDougall.

STEPHENS—GEORGE LESLIE, of Halifax, N.S. Born at Plympton, Eng. Jan. 2nd, 1889; 6 yrs. apprenticeship, marine and mechanical engineering; 1 yr., mechanic on constrn. and repair of naval machinery; with the Royal Canadian Navy as follows:—2 yrs., engine room artificer; 3 yrs., artificer engr.; 2 yrs., (7 mos.), engr. lieutenant; 2 mos., asst. to ch. engr. of H.M.C.S. "Niobe"; at the present time, engr. officer of H.M.C. Naval Depot, Halifax.

References: F. A. Bowman, K. H. Smith, W. G. Yorston, W. P. Morrison, J. L. Allan.

TAIT—ISAAC JOSEPH, of Montreal, Que. Born at Aberdeen, Scotland, June 9th, 1876. Educ. Stewarts Coll. and Heriot-Watt Coll.; 1893, apprenticeship; 1898, with Brown Bros., Edinburgh, general engineering; 1898, (6 mos), electrical engineering, Cribbes & Ross, Edinburgh; 1899-1906, marine engr. and ch. engr. on various ships; 1907, (9 mos), special training in marine turbine constrn. at Fairfield Shipbuilding Co., Glasgow; 1907-11, 2nd engr. and ch. engr., "Royal Edward" and "Royal George"; 1912, (6 mos), asst. mgr., Jeffries & Son, Bristol; 1913, testing engr., Calorolac Limited, Liverpool; 1914-16, ch. engr. in chg. mech. equipment, C. P. R., Montreal; 1917 to date, associate with J. T. Farmer, Montreal.

References: J. A. Shaw, J. S. Costigan, F. A. Combe, J. T. Farmer, G. M. Wynn.

FOR TRANSFER FROM THE CLASS OF ASSOCIATE MEMBER TO THAT OF MEMBER

DALZIEL—NORMAN PEARSON, of Ottawa, Ont. Born at Edinburgh, Scotland, Sept. 20th, 1878. Educ. 1894-6, Heriot-Watt Coll.; 1896-1900, apprentice to Blyth & Westland, Edinburgh; 1900-2, asst. engr. with same firm; 1902-5, asst. engr. Natal Govt. Rlys. and on surveys for railways in Zululand; 1905-13, asst. engr., Mackenzie Mann & Co.; 1913-15, asst. comptroller, same firm; with Imperial Ministry of Munitions as follows:—1915-16, dist. inspector; 1916 to date, chief inspector.

References: H. K. Wicksteed, T. H. White, A. F. Stewart, R. J. Durley, H. T. Hazen.

FREEMAN—J. REGINALD, of Halifax, N.S. Born at Milton, N.S., Mar. 29th, 1881. Educ. I. C. S.; 1½ yrs. inst'man on H. & S. W.; 1 yr. res. and asst. bridge engr. on James Bay Road; 2½ yrs. res. engr., I. C. R.; 1910-11, res. engr. Transcontinental Ry.; 1911 to date, senior asst. engr. to H. A. Russell & W. P. Morrison, Dept. of Public Works, Halifax, N.S.

References: S. J. Fortin, W. P. Morrison, J. L. Allan, F. A. Bowman, L. H. Wheaton, C. O. Foss, E. D. Lafleur.

FRENCH—ROGER DeLAND, of Montreal, Que. Born at North Brookfield, Mass., Aug. 20th, 1885. Educ. B.Sc. and C.E., Worcester Polytechnic Inst.; 1905, (4 mos), dftsman, Standard Plunger Elevator Co., Worcester, Mass.; 1905-6, time keeper, etc. with E. J. Cross, Worcester; 1906, (6 mos), asst. engr. with M. A. Howe, Terre Haute, Ind.; 1906-8, in chg. of extensive alterations, repairs, etc., Worcester Polytechnic Inst.; 1908-10, asst. engr., Commissioners of Sewerage of Louisville, Ky.; 1910-11, asst. engr., National Concrete Constrn. Co., Louisville, Ky.; 1911-18, principal asst. engr. R. S. & W. S. Lea, Montreal; at the present time, partner, Arthur Surveyer & Co.

References: A. Surveyer, W. J. Francis, F. B. Brown, H. M. MacKay, E. Brown, R. S. Lea, W. S. Lea, H. S. Ferguson.

McCLELLAND—RICHARD JAMES, of Kingston, Ont. Born at Kingston, Ont., Feb. 7th, 1870. Educ. Public School; 1901-5, ch. clerk in City Engr.'s office, Kingston; 1905-11, asst. city engr.; 1907 and 1909, engr. town of Gananoque; 1911 to date, city engr., Kingston, Ont.

References: H. B. R. Craig, G. C. Wright, T. S. Scott, W. A. McLean, R. C. Muir, J. Duchastel, A. F. Macallum.

FOR TRANSFER FROM THE CLASS OF JUNIOR TO HIGHER GRADE

COX—OTIS STANLEY, of Halifax, N.S. Born at Upper Stewiacke, N.S., Nov. 11th, 1888. Educ. S.B., Nova Scotia Tech. Coll.; summer 1912, instrument work I. R. C., Dartmouth to Deans Branch; 1913 to date, asst. engr., Public Works Dept., Halifax, N.S.

References: W. P. Morrison, J. R. Freeman, H. N. Putnam, F. A. Bowman, K. H. Smith.

DAWSON—SYDNEY GEORGE, of Ottawa, Ont. Born at Plevna, Ont., Aug. 9th, 1885. Educ. B.Sc., Queens Univ.; 1905-7, rodman on Transcontinental Ry.; summer 1910-12, rodman and dftsman, City Engr's, Ottawa; 1913-14, res. engr. Tunnel Sewers, Edmonton, Alta.; 1915-16, res. engr., Rideau River Sewer, Ottawa; 1916-17, dftsman, Imperial Munitions Board; with Dept. of the Interior as follows:—1917-18, dftsman and jr. office engr., Ottawa; at the present time dist. hydrometric engr., Calgary.

References: W. F. M. Bryce, A. W. Haddow, R. J. Gibb, F. H. Peters, R. J. Burley, J. B. McRae, N. J. Ker.

LAVIGNE—ERNEST J. T., of Quebec, Que. Born at Quebec, Que., Jan. 19th, 1892. Educ. B.A.Sc., Laval Univ. 1916; 1912, (2 mos), dftsman, Tanguay & LeBon; 1 yr., asst. engr., Dept. of Public Works, Quebec District; 1916 to date, third asst. engr., Dept. of Public Works and Labor, Quebec.

References: L. A. Vallée, A. Amos, A. R. Decary, I. E. Vallée, J. E. Gibault, E. A. Hamel, A. Fraser, A. B. Normandin.

MORRISSETTE—ROMEO, of Three Rivers, Que. Born at Three Rivers, Que., May 4th, 1887. Educ. Ecole Polytechnique, Montreal and I. C. S.; 1908, (3 mos), rodman, Three Rivers Coal Dock; 1909-11, asst. engr., Public Works Dept.; 1912, asst. engr., Three Rivers New Coal Dock; 1914, Professor of mech. drafting, Ecole des Arts and Métiers, Three Rivers; at the present time, principal asst. dist. engr., Public Works of Canada, Three Tivers.

References: H. B. Tourigny, J. Lamoureux, F. X. T. Berlinguet, J. Bourgeois, J. J. Collins, J. A. Lefebvre, R. Rinfret.

SPRENGER—HAROLD, of Grand Vital, Man. (On active service.) Born at Leamington, Eng., Aug. 20th, 1889. Educ. County Tech. School, Stafford; Municipal Tech. School, Wolverhampton; 1908, articled to H. M. Whitehead, engr. Cannock Rural District Council; 1910, in chg. of waterworks and sewer constrn.; 1912-14, dftsman, C.N. Ry.; 1914, asst. municipal engr., Rural Municipality of St. Vital, Man.; 1916, enlisted; at the present time, engr. officer, headquarters, Can. Corps Heavy Artillery, France.

References: T. W. Clarke, J. M. L. G. Mullon, M. P. Blair, E. C. Goldie.

ENGINEERING INDEX

In this department will be published from month to month the titles of current engineering papers with the authors and source and a brief extract of the more important, which is designed to give the members of The Institute a survey of all important articles relating to the engineering profession and to every branch of the profession.

AERONAUTICS

AIRPLANE PERFORMANCE DETERMINED BY ENGINE PERFORMANCE, G. B. Upton. The Sibley Journal of Engineering, vol. 32, no. 9, June 1918, pp. 137-142, 3 figs., 3 tables.

AERONAUTICAL PROBLEMS ELUCIDATED BY LESSONS FROM PARADOXICAL WINDWHEELS, Thomas O. Perry. The Michigan Technic, vol. 31, no. 2, May 1918, pp. 80-91, 9 figs.

IL PROBLEMA DEGLI IDROVOLANTI, A. Guidoni. Rivesta Marittima Anno 51, no. 3, March 1918, pp. 191-196, 9 figs. Brief discussion of hydro-aeroplane design.

LATERAL STABILITY OF AN AIRPLANE, Frederick Bedell. The Sibley Journal of Engineering, vol. 32, no. 10, July 1918, pp. 154-156, 11 figs.

THE NEW GIANT GERMAN AEROPLANE. The Engineer, vol. 125, no. 3259, June 14, 1918, p. 512.

WAR AIRPLANES OF TODAY, F. L. Faurote. Automotive Industries, vol. 39, no. 1, July 4, 1918, pp. 14-17, 12 figs. Descriptive paper presented before the summer meeting of the Society of Automotive Engineers in June 1918, at Dayton, Ohio.

THE ENGLISH S. E. V. A. SINGLE-SEATER FIGHTER. Aerial Age Weekly, vol. 7, no. 17, July 1918, pp. 822-825, 7 figs.

AIR MACHINERY

TEST ON ROTARY BLOWERS AND EXHAUSTERS. The Blast Furnace and Steel Plant, vol. 6, no. 7, July 1918, pp. 298-299, 3 figs.

BLAST FURNACES

PRINCIPAL CHANGES IN BLAST FURNACE LINES, J. G. West, Jr. The Blast Furnace and Steel Plant, vol. 6, no. 7, July 1918, pp. 289-296, 26 figs.

BUILDING CONSTRUCTION

COST OF CONSTRUCTING AND MOVING PORTABLE CAMP BUILDINGS. Engineering & Contracting, vol. 49, no. 25, June 19, 1918, p. 614, 3 figs. Figures for special type of portable buildings, 18x54-ft. sleeping quarters, 18x54-ft. kitchen and dining room, 18x18-ft. commissary and 18x18-ft. office, designed by U. S. Office of Public Roads and Rural Engineering for housing 40 men.

HOW A CHAIN FACTORY WAS BUILT AND THEN OCCUPIED, Charles Lundberg. Iron Age, vol. 101, no. 25, June 20, 1918, pp. 1585-1590, 15 figs. Description of plant of Diamond Chain and Mfg. Co., Indianapolis.

CHAINS

TESTS OF CAST STEEL ANCHOR CHAINS. The Marine Review, vol. 48, no. 7, July 1918, pp. 294-297, 15 figs., 3 tables.

HOW CAST STEEL CHAINS ARE MADE, Chester K. Brooks. The Iron Trade Review, vol. 63, no. 1, July 4, 1918, pp. 29-32, 19 figs.

ELECTRIC CAST-STEEL ANCHOR CHAIN, H. Jasper Cox. The Iron Age, vol. 102, no. 1, July 4, 1918, pp. 25-26.

SOME EXPERIMENTS WITH CAST STEEL CHAIN, Chester K. Brooks. The Iron Age, vol. 102, no. 1, July 4, 1918, pp. 26-28, 3 figs., 1 table.

CONVENTIONS

CERAMIC CONFERENCE HELD IN PITTSBURGH. The Clay Worker, vol. 69, no. 6, June 1918, pp. 759 and 790.

IRON AND STEEL INSTITUTE, ANNUAL MEETING, MAY 2-3, 1918:
- Defects in Steel Ingots, J. N. Kilby.
- Non-Metallic Inclusions: Their Constitution and Occurrence in Steel, Andrew McCance.
- A Cause of Failure in Boiler Plates, Walter Rosenhain.
- Effect of Mass on Heat Treatment, E. F. Law.
- The Effect of Cold-Work on the Divorce of Pearlite, J. H. Whiteley.
- Effects of Cold-Working on the Elastic Properties of Steel, J. A. Van Den Broek.
- Iron, Carbon and Phosphorus, Dr. J. E. Stead.
- Presidential Address, Eugene Schneider.
- Committee No. 2—For Blast-Furnace Practice.
- Determination of Cobalt and Nickel in Cobalt Steel, W. R. Schoeffler and A. R. Powell.
- Damascene Steel, Col. N. Delaiew.
- Note on Inclusions in Steel and Ferrite Lines, Dr. J. E. Stead.
- Technical Aspects of Establishment of Heavy Steel Industry in India, with Results of Some Researches Connected Therewith, A. McWilliam.
- Blast-Furnace Bears, Dr. J. E. Stead.
- Copper Tuyeres for Blast-Furnaces, A. K. Reese.
- Fuel Economy in Blast-Furnaces, T. C. Hutchinson.
- Jurassic Ironstones of the United Kingdom Economically Considered, F. H. Hatch.
- Importance of Coke Hardness, G. D. Cockrane

YEARLY MEETING OF THE AMERICAN CONCRETE INSTITUTE. Railway Age, vol. 65, no. 1, July 5, 1918, pp. 17-21, 4 figs.

ELECTRICAL APPLICATIONS

PROTECTING THE PANAMA LOCK VALVES AGAINST ELECTROLYSIS, R. H. Whitehead. Engineering News-Record, vol. 80, no. 26, June 27, 1918, pp. 1219-1221. Describes protective covering applied and wood separators.

ELECTRIC FURNACE FOR FORGING STEEL, Wirt S. Scott. Iron Age, vol. 101, no. 26, June 27, 1918, pp. 1676-1677. Experimental electric forging furnaces of the resistor type leading up to commercially successful units. Silicon carbide as a resistor. From a paper read before the Association of Iron and Steel Electrical Engineers.

POWER-STATION EARTH CONNECTIONS, P. H. Adams, Power, vol. 48, no. 2, July 4, 1918, pp. 40-42, 8 figs. Discussion of proper method of putting down earth connections for electrical equipment and the effect of corrosion in power-plant equipment when the proper attention is not given to maintaining the earth connection at a low resistance.

ENGINEERING MATERIALS

EFFECT OF PHOSPHORUS ON SOFT STEELS, J. S. Unger. Iron Age, vol. 101, no. 24, June 13, 1918, pp. 1538-1540, 3 figs. Results of experiments showing that in soft steels an increase in phosphorus of 0.01 per cent is equivalent to an increase in tensile strength of about 850 lb. per sq. in. From a paper read before the American Iron and Steel Institute, May 1918.

STEELS FOR GEARS AND THEIR TREATMENT, Geo. A. Richardson. The Iron Age, vol. 101, no. 26, June 27, 1918, pp. 1668-1670, 2 figs.

CONCESSIONS MADE IN STEEL STANDARDS. The Iron Trade Review, vol. 63, no. 1, July 4, 1918, pp. 33-35.

A SUMMARY OF IRON AND STEEL PROCESSES. The Blast Furnace and Steel Plant, vol. 6, no. 7, July 1918, pp. 296-297.

PERMISSIBLE STRESSES IN STEEL, Ewart S. Andrews. The Engineering Review, vol. 31, no. 7, January 15, 1918, pp. 199-201, 4 figs.

MALLEABLE CAST IRON, Prof. T. Turner. The Journal of the West of Scotland Iron and Steel Institute, vol. 25, no. 6, March 1918, pp. 285-302, 17 figs.

FOUNDRY

WESTINGHOUSE PLANT AT SOUTH BETHLEHEM. Iron Age, vol. 102, no. 1, July 4, 1918, pp. 22-24, 5 figs. A description of the interesting features of equipment of foundry and forging machine and erection shops.

FUELS AND FIRING

Pitch as a Fuel for Power Generation, John B. C. Kershaw, Power, vol. 47, no. 26, June 25, 1918, pp. 904-906. A summary of the most recent patents and experiments relating to the use of coal-tar pitch as a fuel for steam boilers and for internal-combustion engines.

Economic Handling of Ashes, Reginald Trautschold. Industrial Management, vol. 56, no. 1, July 1918, pp. 17-20.

Report of Committee on Fuel Economy and Smoke Prevention. Railway Age, vol. 64, no. 25, June 21, 1918, pp. 1516-1519, 1 fig.

FURNACES

By-Product Coke Oven Pressure Regulation, Charles H. Smoot. The Blast Furnace and Steel Plant, vol. 6, no. 7, July 1918, pp. 306-310, 2 figs. First of a series of articles dealing with the subject of by-product coke-oven pressure regulation. The general theory of regulation is discussed.

HOISTING MACHINERY

A Large Electric Crane, H. Y. Stukye. American Machinist, vol. 49, no. 2, July 11, pp. 71-72, 3 figs. Description of an electric traveling crane with total lifting capacity of 431 net tons.

Federal Ships Erected by Derrick Travelers Built for Long Service. Engineering News-Record, vol. 80, no. 24, June 13, 1918, pp. 1129-1132, 6 figs. Problem studied on basis of bridge-erection experience; derricks of pillar-crane type; low stresses and special bearings for reliability; gantry truck details from shop traveler practice.

Operation and Maintenance of Elevators—Geared Traction Machines, R. H. Whitehead. Power, vol. 47, no. 26, June 25, 1918, pp. 900-903, 8 figs. Construction and operation of three geared types of traction-elevator machines discussed.

INTERNAL-COMBUSTION ENGINEERING

Two Essential Conditions for Burning Tar-Oil in Diesel Engines, P. H. Smith. Page's Engineering Weekly, vol. 32, no. 716, May 31, 1918, pp. 256-257. Paper read before the Diesel Users' Association (British). The conditions of which the writer speaks are atomization and turbulence. The sleeve pulverizer system is discussed in particular.

Some Notes on the Operation of Gas and Oil Engines, Part 2, Water Cooling, Jas. G. Walthew. Gas and Oil Power, vol. 13, no. 153, June 6, 1918, pp. 125-126, 2 figs., 1 chart.

Details of High-Speed Internal Combustion Engines, Harry R. Ricardo Engineering, vol. 105, no. 2735, May 31, 1918, pp. 620-623, figs. 8-28. Continuation of paper read on April 30 before the Northeast Coast Institution of Engineers and Shipbuilders at Newcastle-upon-Tyne. Subjects discussed in this issue: volumetric efficiency of engine; design of pistons; a comparison of wear and tear on slow and high-speed engines. Profusely illustrated with drawings and curves.

Effect of Circulating Water Temperatures on the Lubricating Oil Used in Internal Combustion Engines. Lubrication, vol. 5, no. 8, June 1918, pp. 11-14, 1 fig.

Two-Stroke Engines, George Funck. The Automobile Engineer, vol. 8, no. 115, June 1918, pp. 154-158, figs. 8-13. Second installment of an extensive serial article on the theory and design of two-stroke-cycle engines.

The Possibilities of the Hvid Engine, E. B. Blakely. Gas Engine, vol. 20, no. 7, July 1918, pp. 341-347, 9 figs. Description of the four-cycle Hvid-type motor using kerosene and heavier oils with ignition by heat of compression, with results of tests made on a 5¾ x 9 engine. Paper read before the National Gas Engine Association, June 1918.

Conservation of Motor Fuel as Affected by Lubricating Oil, S. F. Lentz. Gas Engine, vol. 20, no. 7, July 1918, pp. 327-333. Results of experiments showing change of physical state of oil during use in motors. Abstract of paper read before the National Gas Engine Association, June 1918.

The Semi-Diesel Oil Engine, L. H. Morrison. Power, vol. 48, no. 2, July 9, 1918, pp. 47-49, 7 figs. Points out a difference between semi-Diesel and low-compression oil engines and discusses some types of the former.

LABOR

Training Shipyard Workers by Emergency Fleet Corporation Methods, R. V. Rickford. International Marine Engineering, vol. 23, no. 6, June 1918, pp. 325-328, 4 figs.

Piece Work System in Railway Shops, W. J. McClennan. Railway Mechanical Engineer, vol. 92, no. 7, July 1918, pp. 411-416, 5 figs. A discussion of the organization of the methods for determining proper prices, and of the forms used.

A System of Labor Compensation, M. K. Smogorjevsky. Railway Mechanical Engineer, vol. 92, no. 6, June 1918, pp. 325-329, 2 figs. A combination of the Taylor, piece-work and Prusso-Hessian methods developed in a Russian railway shop.

The Labor Problem of a Great French Shell Factory, Robert K. Tomlin, Jr. American Machinist, vol. 49, no. 1, July 4, 1918, pp. 22-24, 8 figs.

Lot Cost System in Making Winchester Guns, W. E. Freeland. Iron Age, vol. 102, no. 1, July 4, 1918, pp. 8-10, 4 figs. Bonus payments to machine adjusters and instructors a feature of the production system; some of the cost forms used.

Americanization a Problem in Human Engineering, Henry D. Hammond. Engineering News-Record, vol. 80, no. 24, June 13, 1918, pp. 1116-1119.

The Future of the Apprentice, C. C. Harmann. Machinery, vol. 24, no. 10, June 1918, p. 889. Results of present training methods and suggestions for an improved course.

LUBRICATION

The Lubrication of Machine Shop Equipment. Lubrication, vol. 5, no. 8, June 1918, pp. 2-5. A general discussion of the subject presented by the Lubricating Engineering Association with the main purpose of showing how proper lubrication may help to eliminate noise and to prolong the life of machines and tools.

Waste Oil Troubles, W. A. Taller. National Engineer, vol. 22, no. 7, July 1918, pp. 296-298, 1 fig.

MARINE ENGINEERING

Welding Ship's Parts Together, James G. Dudley. International Marine Engineering, vol. 23, no. 6, pp. 359-360, 4 figs. An account of the development of the electric welding of ships by the Emergency Fleet Corporation.

Ferro-Concrete Ships, T. J. Gueritte. International Marine Engineering, vol. 23, no. 6, pp. 329-334. Discussion of materials and systems of construction; plastered and molded ships; weight, cost and durability. Paper read before the North-East Coast Institution of Engineers and Shipbuilders, Newcastle-upon-Tyne, March 1918.

Government Designs and Builds 3500-Ton Concrete Ships. Engineering News-Record, vol. 81, no. 1, July 4, 1918, pp. 17-21, 7 figs. Shape and size of vessels under construction follow standard wooden ships of same tonnage. Usual concrete details adapted to sea-going ships.

Design Steel Ships for Maximum Efficiency of Bridge-Shop Fabrication. Engineering News-Record, vol. 81, no. 1, July 4, 1918, pp. 5-12, 13 figs. Description of the fabricated-ship construction at the Hog Island plant and some of the features of construction.

MACHINE PARTS

Ingenious Mechanical Movements, Franklin D. Jones. Machinery, vol. 24, no. 10, June 1918, pp. 902-908, 10 figs. Second of a series of articles on mechanism.

Bearings for Machine Shop Equipment, Edward K. Hammond. Machinery, vol. 24, no. 11, July 1918, pp. 975-987, 21 figs. First of a series of articles. Deals with various forms of plain bearings which have demonstrated their ability to give satisfactory service.

MACHINE SHOP

Drop Forging Problems Discussed. The Iron Age, vol. 101, no. 26, June 27, 1918, pp. 1650-1654.

Grinding and Lapping Threads, J. E. Lindgren. Machinery, vol. 24, no. 11, July 1918, pp. 1023-1024, 5 figs. Attachments, fixtures and laps used for producing accurate threads.

Manufacturing Wright Roller Bearings. Machinery, vol. 24, no. 11, July 1918, pp. 1019-1021, 9 figs. Description of the processes involved in machinin gparts, heat-treating, assembling and inspecting.

Operating the Gridley Automatic Turret Lathe—1. Douglas T. Hamilton. Machinery, vol. 24, no. 10, June 1918, pp. 926-931, 16 figs. Complete instructions for tooling, setting up, and operating. 2, July 1918, pp. 1016-1018, 4 figs. Examples of camming and setting tools.

Manufacturing Operations on Jewelry Settings, J. V. Hunter. American Machinist, vol. 49, no. 2, July 11, 1918, pp. 47-52, 16 figs.

Manufacturing the Curtiss Airplane Cylinder, II The Water Jacket, G. A. Ranger. American Machinist, vol. 49, no. 2, July 11, 1918, pp. 62-65, 15 figs. Describes preparation of the Monel metal jacket and the brazing operations.

Work in a Texas Repair Shop, Frank A. Stanley. American Machinist, vol. 49, no. 2, July 11, 1918, pp. 53-56, 13 figs. Description of a varied line of work in the blacksmith shop and structural department of a large smelter; bending, forming and welding operations; some special tools.

Design and Construction of Work-Benches, Frank H. Mayoh. Machinery, vol. 24, no. 10, June 1918, pp. 880-886, 24 figs. Bench legs and tops; location of benches; portable work benches.

Metallic Electrode Arc Welds, O. S. Eschholz. Railway Mechanical Engineer, vol. 92, no. 7, July 1918, pp. 416-419, 7 figs. Suggestions for determining the quality of the joint; proper methods which will secure good results.

Fusion Welding Fallacies—1, S. W. Miller. Machinery, vol. 24, no. 11, July 1918, pp. 1014-1015, 5 figs. Some common beliefs and why they are unsound.

Arc Welding of Mild Steel, O. H. Eschholz. The Electric Journal, vol. 15, no. 7, July 1918, pp. 247-250, 13 figs.

Effect of Mass on Heat Treatment, E. F. Law. Engineering, vol. 105, no. 2736, June 7, 1918, pp. 647-650, 17 figs.

Bluing Steel, W. B. Greenleaf. Machinery, vol. 24, no. 11, July 1918, pp. 997-998, 2 figs. Materials, arrangements and methods used on light sheet-steel work.

Heat Treatment of Axles, Dwight D. Miller. Railway Mechanical Engineer, vol. 92, no. 7, July 1918, pp. 419-421, 3 figs. The scientific heat treatment of locomotive and car axles made possible by use of electric furnace.

MACHINE TOOLS

A New Nut Making Machine. The Engineer, vol. 125, no. 3259, June 14, 1918, pp. 510-511, 3 figs.

Designs High-Cutting Speed Planer. The Iron Trade Review, vol. 63, no. 1, July 4, 1918, pp. 22-23, 1 fig.

Intensive Production on Drilling Machines—1, Edward K. Hamilton. Machinery, vol. 24, no. 10, June 1918, pp. 914-921, 5 figs. Organization of the drilling department and use of special equipment on machine to adapt them for a wide range of work. 2, July 1918, pp. 1030-1034, 12 figs. Design of cutting tools and work-holding fixtures for handling turned lathe work on drilling machnine.

The Inspection of Machine Tools, Ethan Viall. American Machinist, vol. 49, no. 1, July 4, 1918, pp. 13-17, 15 figs. Description of testing methods used in some well-known machine-tool building shops.

War-Time Repairs in the Navy—III, General Repair Work, Frank Stanley. American Machinist, vol. 48, no. 26, June 27, 1918, pp. 1091-1094, 10 figs. The making of small and medium-sized parts. Overhauling machine tools for ships.

Results of Faulty Tool Designing, F. B. Jacobs. Machinery, vol. 24, no. 11, July 1918, pp. 1028-1029, 9 figs. Examples of tools and fixtures that did not work, with reasons for failures.

The Wilt Process of Twist Drill Manufacture, Franklin D. Jones. Machinery, vol. 24, no. 11, July 1918, pp. 1007-1013, 11 figs. A process in which all machining operations on twist drills, except grinding, are done automatically.

Supports for Milling Machine Arbors, Luther D. Burlingame. Machinery, vol. 24, no. 11, July 1918, pp. 992-996, 18 figs. Historical review showing early designs with the development of types now used.

MEASURING APPARATUS AND METHODS

Universal Milling Machine Dynamometer, R. Poliakoff. Machiery, vol. 24, no. 10, June 1918, p. 932, 4 figs. Describes a dynamometer designed for measuring the pressure that a milling-machine cutter exerts on the work and on the various parts of the milling machine through the work.

Indicator Gages Used in Gasoline-Engine Construction, C. C. Marsh. Machinery, vol. 24, no. 10, June 1918, pp. 910-913, 5 figs. Gages for inspecting cylinder depth, length, external diameter, camlift, profile and eccentricity.

Contour and Radius-Measuring Instrument. Machinery, vol. 24, no. 10, June 1918, pp. 898-899, 5 figs. Universal type of instrument for measuring irregular profiles, radius gages and contours that cannot be tested by ordinary measuring devices.

Example of Precision Gage Making. Machinery, vol. 24, no. 10, June 1918, pp. 878-879, 5 figs. Methods of making and testing a gage requiring unusual accuracy.

Distantiagraph, W. D. Farris. Proceedings of the U. S. Naval Institute, vol. 44, no. 181, March 1918, pp. 557-559, 3 figs. Describes an instrument designed to determine the actual distance a ship must pass over a light or point.

Gages and Thermometer, John E. Starr. Refrigerating World, vol. 53, no. 6, June 1918, pp. 11-12.

Viscosity Determinations in Absolute Units. Engineering, vol. 105, no. 2737, June 14, 1918, pp. 655.

MECHANICS

Non-Molecular Structure of Solids, Arthur H. Compton. Journal of The Franklin Institute, vol. 185, no. 6, June 1918, pp. 745-774, 15 figs.

Approximate Live-Load Stresses in Railway Bridges, H. R. White. Engineering News-Record, vol. 80, no. 24, pp. 1137-1138, 2 figs. Linear formula for floor-beam concentration giving shears and moments easily.

Designing Wall Beams in Concrete Flat-Slab Buildings, Albert M. Wolf. Engineering News-Record, vol. 80, no. 24, June 13, 1918, pp. 1124-1126, 3 figs.

Equivalent Uniform Loads for Concrete Beams, Albert J. Becker. Engineering & Contracting, vol. 49, no. 26, June 26, 1918, pp. 633-635, 3 figs. Method of calculating special beams with partial or non-uniform loads.

Formulas for Calculating Thickness and Reinforcement for Concrete Conduit, L. Robert de la Mahotière. Engineering & Contracting, vol. 49, no. 24, June 12, 1918, pp. 591-593, 4 figs. A translation from Le Génie Civil. Based on assumption of empty conduit supporting a uniform load on upper half; thickness of conduit constant.

MILITARY ENGINEERING

Condotta e Osservazione del Tiro Terrestre, Giuseppe Fioravanzo. Rivista Marittima, Anno 51, no. 3, March 1918, pp. 173-190, 11 figs. An extensive mathematical article on land artillery fire.

MUNITIONS

ROUTING AND HANDLING SHELLS, James Forest. Machinery, vol. 24, no. 10, June 1918, pp. 922-925, 8 figs. General production methods and short cuts on larger shells.

THE MANUFACTURE OF THE LEWIS MACHINE GUN, X. THE BOLT AND FEED OPERATING STUD—1, Frank A. Stanley. American Machinist, vol. 49, no. 1, July 4, 1918, pp. 25-29, 9 figs. Description of the machining operations.

FORGING THE U. S. 75-MILLIMETER SHELL, Erik Oberg. Machinery, vol. 24, no. 10, June 1918, pp. 890-897, 20 figs. Fourth of a series of articles describing approved methods employed in the forging and machining of the U. S. 75-mm. shell.

BY-PRODUCT COKE INDUSTRY IN WAR TIME, William H. Blauvelt. The Iron Age, vol. 101, no 24, June 13, 1918, pp. 1544-1545. Importance of the by-product method in coal conservation; furnishing raw materials for high explosives; keystone products, bases of important industries. From paper read before the American Iron and Steel Institute, May 1918.

SIDELIGHTS ON WINCHESTER GUN PRODUCTION, W. E. Freeland. The Iron Age, vol. 101, no. 24, June 13, 1918, pp. 1521-1526, 9 figs. Control of tools and gages; foremen held responsible for inspection; time study methods and satisfactory results.

POWER-PLANT ENGINEERING

ESTIMATING POWER REQUIREMENTS OF A LOCALITY, Ludwig W. Schmidt, Power, vol. 48, no. 2, July 9, 1918, pp. 55-56.

PUMPS

A LOG BOOK FOR AN ELECTRICALLY DRIVEN PUMPING UNIT AT NEW BEDFORD, R. C. P. Coggeshall. Journal of the New England Water Works Association, vol. 32, no. 2, June 1918, pp. 173-179, 1 fig., 1 chart.

WATER-WORKS PUMP WITH HIGH EFFICIENCIES. Power, vol. 48, no. 1, July 2, 1918, p. 16, 1 fig. Results of efficiency tests of two 12-in. motor-driven centrifugal pumps.

RAILROAD ENGINEERING

STANDARDIZATION OF INDIAN RAILWAYS' LOCOMOTIVES, E. C. Poultney. Railway Age, vol. 64, no. 24, June 14, 1918, pp. 1425-1430, 9 figs., 3 tables.

TESTS WITH 2 10-2 LOCOMOTIVE ON THE UNION PACIFIC. Railway Age, vol. 64, no. 26, June 28, 1918, pp. 1573-1574, 3 figs.

DESIGN AND MAINTENANCE OF LOCOMOTIVE BOILERS. Railway Age, vol. 64, no. 25, June 21, 1918, pp. 1522-1523.

SEMI-ELLIPTIC SPRINGS—MANUFACTURE AND REPAIR. Railway Age, vol. 64, no. 25, June 21, 1918, pp. 1528-1531, 10 figs.

SMALL LOCOMOTIVES OF SPECIAL TYPES. The Engineer, vol. 125, no. 3239, June 14, 1918, pp. 507-510, figs. 19-26.

FEED WATER HEATERS, J. Snowden Bell. Railway Review, vol. 63, no. 1, July 6, 1918, pp. 14-16, 3 figs.

NORFOLK & WESTERN 267-TON MALLET LOCOMOTIVE, H. W. Reynolds. Railway Age Gazette, vol. 65, no. 2, July 12, 1918, pp. 59-63. Details of design of a 2-8-8-2- Mallet locomotive and tender built at the Norfolk & Western Shops, Roanoke, Va.

LOCAL STRESSES IN BOX BOLSTERS, L. E. Endsley. Railway Mechanical Engineer, vol. 92, no. 6, June 1918, pp. 343-348, 15 figs. Tests of loaded bolsters with Berry strain gage showing effect on strength of design details. Abstract of paper read before St. Louis Railway Club, May 1918.

THE RAILWAY SHOP TOOL ROOM, M. H. Williams. Railway Mechanical Engineer, vol. 92, no. 6, June 1918. pp. 335-340, 7 figs. The importance of the tool room and its equipment.

DRAFTING MODERN LOCOMOTIVES, H. W. Coddington. Railway Mechanical Engineer, vol. 92, no. 6, June 1918, pp. 331-333, 3 figs.; no. 7, July 1918, pp. 387-392, 10 figs. Improvements effected by a study of draft conditions on Norfolk & Western 4-8-2 type engines.

THE LIGHT RAILWAY ALONG THE BRITISH FRONT AT CLOSE RANGE, Robert K. Tomlin, Jr. Engineering News-Record, vol. 80, no. 25, June 20, 1918, pp. 1162-1169, 15 figs. Where and how lines are built; how maintained and how operated; what they have accomplished.

A WELL-ORGANIZED REPAIR SHOP. Railway Mechanical Engineer, vol. 92, no. 6, June 1918, pp. 303-311, 15 figs. A study of methods followed in repairing locomotives on the New York Central at West Albany.

RECLAMATION ON THE SOUTHERN PACIFIC, Frank A. Stanley. Railway Mechanical Engineer, vol. 92, no. 7, July 1918, pp. 381-386, 12 figs. First installment. Describes the extensive salvage work done in the road's Sacramento shop.

DOINGS OF THE UNITED STATES RAILROAD ADMINISTRATION. Railway Age Gazette, vol. 65, no. 2, July 12, 1918, pp. 48-57. Action of freight classification, valuation, mileage, etc.

REFRIGERATION

COLD ACCUMULATORS AND THEIR APPLICATION, Ernest S. H. Barrs. Power, vol. 48, no. 1, July 2, 1918, pp. 31-33, 2 figs.

STEEL FRAME REFRIGERATOR CARS, E. G. Goodwin. Railway Mechanical Engineer, vol. 92, no. 7, July 1918, pp. 401-405, 10 figs. Description of Norfolk & Western design with bunched insulation, insulated bulkheads and conduit floor racks.

STEAM ENGINEERING

INTERPRETING STEAM-TURBINE TEST CURVES, H. E. Brelsford. Power, vol. 47, no. 25, June 18, 1918, pp. 866-868, 5 figs. Brief description of standard turbine test curves and how they are derived and used in interpreting turbine characteristics.

EFFECT OF FEED-WATER TEMPERATURE AND RATE OF INJECTION UPON STEAM FLOW, Frank G. Philo. Power, vol. 47, no. 26, June 25, 1918, pp. 915-916, 1 fig., 1 table.

IMPROVING PLANT CONDITIONS, A. W. Blom. Power, vol. 48, no. 1, July 2, 1918, pp. 11-12, 4 figs. How changes were made to prevent air from leaking past the end of chain-grate stokers. Description of a feed-water heater working on the jet-condenser principle.

REMODELING THE ST. LOUIS BADEN STATION, K. Toensfeldt. Power, vol. 47, no. 25, June 18, 1918, pp. 862-865, 4 figs. Remodeling a station of 3300 boiler horsepower at a total investment cost of $177,500 for an estimated saving in yearly operating expenses of $11,797.

TABLE OF B.T.U.'S PER BOILER HORSEPOWER AT VARIOUS EFFICIENCIES, Charles H. Bromley. Power, vol. 48, no. 2, July 9, 1918, p. 46.

SOME CAUSES OF BOILER-TUBE FAILURES, R. Cederblom. Power, vol. 48, no. 2, July 8, 1918, pp. 43-46, 4 figs. Theory advanced that failure of tubes through blistering is due to steam formation in the tube preventing the water from sweeping the tube surface and keeping it cool. How to minimize the trouble; influence of baffling on steam generated per square foot of tube.

CAUSES OF VACUUM TROUBLE, L. F. Forseille. Power, vol. 47, no. 26, June 25, 1918, p. 909, 1 fig. An analysis of trouble experienced in the maintenance of a normal vacuum on a 10,000-kv.a. turbine unit equipped with a jet type of condenser.

MAIN AND AUXILIARY STEAM PIPING, Ralph W. Propert. The Journal of the American Society of Marine Draftsmen, vol. 5, no. 1, April 1918, pp. 9-11.

SOOT BLOWERS FOR HORIZONTAL WATER-TUBE BOILERS. Power, vol. 48, no. 1, July 2, 1918, pp. 2-7, 19 figs. An extensive discussion of the subject of soot blowers with special reference to the different types of mechanical blowers on the market and their application to the various boilers in use.

GASKET FOR STEAM-PIPE LINES, Zeno Schultes. Power, vol. 48, no. 1, July 2, 1918, pp. 8-10, 4 figs. General discussion of the subject of packing for steam pipe lines. The author claims that flanged pipe joints are particularly apt to leak and explains it by the presence of rough flange faces, large bolt holes and holes spaced too far apart.

EMPLOYMENT BUREAU

A Clearing House of Engineering Position in Canada.

This department is one of the features by which it is hoped to be of greater service to the engineer and particularly the younger men. Firms and individuals requiring engineering assistance will have their inquiries listed in this department. Those out of employment or desirous of a change are invited to make use of it, without charge and in confidence.

Engineers as Executives

It is a pleasure to reproduce herewith the contents of a letter from F. J. Bell, M.E.I.C., President, Leaside Munitions Company, which indicates, as has already been pointed out in these columns, that the industrial life of the country is capable of absorbing more and more of the engineering profession in a manner that will place them in the position of occupying places of executive responsibility in the future. Mr. Bell's letter states:

"We are erecting new shops at Leaside for the purpose of forging and machining 12" American shells and we are now adding to our organization to take care of the general operation of the new plant. We find that only a small percentage of mechanics, on being advanced to positions where some executive and organizing ability is required, prove successful. We are giving preference to every man in our employ who shows ability, but with the new work coming on we require a number of capable men in addition to our present staff. We have had pretty good results in taking men of engineering training who have had some experience in handling gangs and breaking them in to our general methods and in a very short time they become first-class foremen and eventually superintendents. We would like to have our requirements known to your members so that anyone who feels like making an application could do so at once and I may say that there are good opportunities for any bright and active engineers of ability with our firm. When speaking of engineers I refer to either mechanical, electrical or civil and a University training is not essential for our requirements."

Situations Vacant

Superintendents.

Two superintendents wanted for manufacturing plant, who will have general supervision of the plant, one for night and the other for day; must have had experience in handling men and mechanical and electrical experience. These positions offer splendid opportunities. Address applications to Box No. 1, Employment Bureau.

Mining Engineer.

Position is open for a junior engineer to commence as surveyor with a large mining corporation in northern Ontario. This position offers good prospects. Address applications to Box No. 4

Mining Chemist.

Mining chemist capable of making assays of all minerals and of looking after the chemical requirements of a mining corporation. Address applications to Box No. 5.

Works Engineer.

One capable of taking off accurate quantities for mechanical equipment from engineers' drawings and who has a fair idea of the cost of various machine shop operations, pattern making, and the installation of steam lines, shafting and general mill equipment. This position offers $130.00 to $150.00 per month to start and promises a good opening later. Address Box No. 8.

Mechanical Draftsman.

Wanted for large industrial company, mechanical draftsman with technical education and a few years experience, one who is quick and energetic and capable of designing. State qualifications, experience and salary expected, to Box 9.

Inspectors.

Three inspectors for dock construction, pile driving and concrete work, and one timber inspector, required by Steel Corporation. In writing, give experience, salary expected, age and standing in regard to military service. Apply Box No. 10.

Draftsman.

Draftsman for railway office in New Brunswick. A young man who is willing to work his way upwards. Apply Box No. 11.

Instrumentman.

At once, competent instrumentman wanted for Canadian Government Rlys. Apply Box No. 12.

Draftsmen.

Wanted by large shipbuilding corporation, competent draftsmen for structural, mechanical and marine work. This work is important from a military point of view and offering liberal terms. Only first class men wanted. Apply to Box No. 13.

Engineers for Construction.

A large contracting company having taken on several new contracts requires a number of engineers of construction, men with experience in engineering construction. Apply Box No. 14.

Instrumentman.

An experienced instrumentman wanted, preferably a young university graduate, for the Engineering Department of a railway company in Quebec Province. Address Box No. 15.

Draftsmen.

Several mechanical draftsmen required for Steel Corporation. Apply Box No. 16.

Testing Expert.

Wanted by Ordnance Department of United States Government, mechanical engineer familiar with micrometer and heat testing methods to be employed in Canada. young college graduate preferred. Address Box No. 17,

Transitman.

For temporary work with railway office, experienced transitman for Montreal and vicinity. Address Box 18.

PROGRAMME OF THE THIRD GENERAL PROFESSIONAL MEETING HALIFAX, N.S.

FIRST SESSION.

9 a.m., Wednesday, September 11, 1918

9.00 A.M. Opening of Meeting.
Address of Welcome—By His Honour, the Lieutenant-Governor of Nova Scotia.
Address of Welcome—By the Mayor of Halifax, N.S.

9.30 Business.

10.00 A.M. to 1.00 P.M. Some Notes on Preservation of Timber for Use in Salt Water—C. E. W. Dodwell, M.E.I.C., District Engineer, Public Works Dept., Halifax.
Discussion.

Economic Aspects of Halifax Ocean Terminals—A. E. Macleod, Accountant, Halifax Ocean Terminals.
Discussion.

Town Planning, Halifax and Vicinity—H. L. Seymour, A.M.E.I.C., Town Planning Assistant, Commission of Conservation.

1.00 Luncheon at the "Green Lantern".

2.30 p.m., Wednesday, September 11, 1918

Trips by auto through devastated area, and by train over Terminal Railway to Ocean Terminals.

6.30 Tea at Waegwoltic.

SECOND SESSION.

8 p.m., Wednesday, September 11, 1918

8.00 P.M. Diving Bell in use at Halifax Ocean Terminals, (illustrated)—J. J. MacDonald, A.M.E.I.C., Assistant Engineer, Halifax Ocean Terminals.
Discussion.

THIRD SESSION.

9.00 a.m., Thursday, September 12, 1918

9.00 A.M. to 1.00 P.M. St. John Harbour Works—Alex. Gray, M.E.I.C., Harbour Engineer, Public Works Dept., St. John; Chairman St. John Branch, E. I. C.
Discussion.

St. John Railway Terminals—C. C. Kirby, A.M.E.I.C., Divisional Engineer, C.P.R.
Discussion.

Visiting members will be guests of the Commercial Club at luncheon.

FOURTH SESSION.

2.30 p.m., Thursday, September 12, 1918

2.30 to 4.00 P.M. Use of Reinforced Concrete in Harbour Work.—A. F. Dyer, A.M.E.I.C., Engineer, Furness Withy Co., Halifax.
Discussion.

4.00 Excursion on Harbour, as guests of Board of Trade.

FIFTH SESSION.

8 p.m., Thursday, September 12, 1918

8.00 P.M. The Quebec Bridge (illustrated)—G. F. Porter, M.E.I.C. At the Hall of the School for the Blind, Morris St. Public invited.

SIXTH SESSION.

9 a.m., Friday, September 13, 1918

9.00 A.M. Halifax Ocean Terminal Railway—R. H. Smith, A.M.E.I.C., Resident Engineer, Ocean Terminal Railway.
Discussion.

Address by representative, Halifax Board of Trade.

2.30 p.m., Friday, September 13, 1918

VISITS AND EXCURSIONS

Arranged to suit individuals or groups, to such points as:
New Telephone Exchange, Sackville Street
Imperial Oil Company's Works
Woodside Sugar Refinery
Halifax Ship Yards
Nova Scotia Tramway & Power Company's Power House
Park and Public Gardens.

All sessions, except Mr. Porter's lecture, will be held in the rooms of the Halifax Board of Trade, Hollis Street, corner of Duke Street.

Section 44 of the By-Laws reads as follows:

"General Professional Meetings of the Institute may be held once a year in each province, subject to the approval of the Council, and also at such places and times as the Council may direct, for the presentation of papers and the discussion thereof, visiting engineering works of interest and generally for professional intercourse. Such meetings shall be conducted by the Officers of the Provincial Division in the province in which the meeting is held, or if no Provincial Division has been established therein, by the officers of a branch in that province, to be selected by the Council. The Secretary of the Institute shall act as Secretary of the meeting and shall furnish a report of the meeting for the Transactions of the Institute."

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SECOND GENERAL PROFESSIONAL MEETING

A discussion of the engineering problems of the Prairie Provinces including Good Roads, Water and Sanitation, Concrete, Fuel and Professional and Institute Affairs, Saskatoon, August 8th, 9th and 10th, 1918.

First Session
3 p. m., Thursday, August 8th, 1918.

GOOD ROADS

IN opening the first session, President H. H. Vaughan, M.E.I.C. expressed his pleasure in being present and in being able to welcome so many of the leading members of the profession in Western Canada, many of whom had come great distances to attend the second professional meeting of the Institute, and the first to be held West of the Great Lakes. Professional meetings had been established as a result of a suggestion made by him to the Committee on Society affairs, and they were designed to bring the men from different parts of the country together to get acquainted, hear papers, visit engineering works, and discuss problems of mutual interest. It has already been shown that these meetings will be of the greatest possible benefit to the profession and will do much to strengthen the engineering Institute.

The meeting in Toronto had been very successful; the attendance already assured the success of the present gathering; and the third professional meeting of the year—to be held in Halifax next month—would likewise stimulate the men in Nova Scotia and New Brunswick. Gathering together in this manner was calculated to develop better engineers, as a man who does no mix with his fellows is apt to be narrow in his viewpoint.

The Institute was indeed fortunate to be able to hold the meetings in the buildings of the University of Saskatchewan, where Dr. W. C. Murray, President of the University, had kindly not only arranged for the place of meeting, but had made it possible for most of the visiting members to be quartered in the University.

It was a great pleasure to have Dr. Murray in attendance at the first meeting, as he knew that all present would be glad to have him address the meeting.

Dr. Walter C. Murray:

"Mr. President and gentlemen, it is a very great pleasure for us to have the privilege of hearing you and seeing you. We realise the honour you have done us, and done Saskatoon, in selecting the University as your place of meeting. The University is one of the youngest in the West, and its youth, perhaps, causes us to say very little of it, but we would like those who have come from the East and other portions of Canada, to remember that this is practically a new institution. We have here in this University the organized schools of Art, of Law, of Agriculture, of Pharmacy, and of Engineering. The Civil Engineering Department has suffered more from the war than any other, but we have with us Professor Greig, who is a typical engineer, and consequently when we require anything done he is the one to whom we turn for its accomplishment. The war has been synonymous with waste, and has so impressed those in authority that all waste is being eliminated by salvaging as far as possible, although it is impossible to restore the human destruction caused thereby. We hear of waste in mining, in manufacturing, and by fire, and now serious steps are being taken to have it overcome. I believe the engineers have the training, the talent, the habits, that will enable the people to meet those problems, and to the engineering profession we look with more hope and with greater confidence than to any other body for meeting this problem. I believe the problem of rehabilitation is one which we look to your profession to meet.

I hope and trust that your stay with us will be pleasant, and assure you that anything the University can do to make it such will be done." (Applause).

President Vaughan:

"I am sure we are very much indebted to Dr. Murray for his welcome, and also for the things he has said in his address. We shall be very glad to have Dr. Murray stay with us and attend our meetings." Continuing, Mr. Vaughan announced the first paper on the programme, The Location, Construction and Maintenance of Earth Roads by H. R. MacKenzie, A.M.E.I.C. chief field engineer, Province of Saskatchewan, Highway Department, which was read by the author.

The Location, Construction and Maintenance of Earth Roads.

At least ninety per cent of the total road mileage in the prairie provinces will remain as earth roads indefinitely. A similar percentage of unsurfaced roads still exists in the older settled areas of Canada and the United States, hence it is evident that the various matters pertaining to the proper construction and maintenance of this type of road are of vital importance; but it is impossible in a reasonably short article to deal, except in a very general manner, with the comprehensive subject assigned the writer, consequently we shall confine our attention to particular phases.

Location.

One of the greatest defects in road building, and one of the most expensive to remedy, is faulty location. Many of the first roads built in the Province of Saskatchewan had grades of from fifteen to twenty per cent and most of these excessive grades could easily have been avoided had proper attention been paid to location. The apparent object of some of these pioneer road builders was

to reach the summit of a hill by the shortest route, thereby reducing the length of roadway requiring to be constructed. This is false economy, for although road surfaces may wear away, culverts and bridges require to be renewed, still the location of a road stands for all time as a monument to the ability or to the lack of foresight, of the road supervisor responsible for such location.

In Saskatchewan owing to the rectangular system of survey adopted, the Engineer is given very little latitude as to the location of the right of way, except where it is not feasible to adhere to the surveyed road allowance, but this fact does not eliminate the necessity for engineering supervision in the location of roads on the surveyed right of way, because the subject of grade is inseparable from that of location and the determination of a suitable grade line over hilly areas may properly be considered as location in a restricted sense, and in this article the writer proposes to deal with the subject of location in the sense of the obtaining of suitable grades and a satisfactory road-bed along a general route previously determined.

The maximum grade adopted by the Highway Department of this Province is seven per cent and where the natural slope of a road allowance is such that reasonable amounts of excavation and embankment are not sufficient to reduce the grade to that maximum, a new location is made. This maximum is not always adopted by the municipal officials in connection with the expenditure of local funds, but is insisted on, in case of all road improvements performed by the municipal officials with funds advanced in whole or in part by the provincial authorities.

The most frequent error in road building in this Province is the adherence to road allowances when suitable grades cannot be obtained, or where the cost of improvement is excessive. Steep grades mean accumulating losses due to restricted tonnage and excessively high maintenance charges. Such roads are finally abandoned in favor of new locations where suitable grades can be obtained, often with the expenditure of a less amount than was wasted in attempting to adhere to the surveyed road allowance. Many settlers in this province take serious objections to diverting from the surveyed right of way. Some of the objections are, of course, based on the disinclination to sell part of one's own land for a roadway, or to expropriate land from a neighbour, but the other objection most frequently met with is that the roadway is lengthened by diverting around a hill. This objection is well founded in a great many cases, but the fact that "the bail of a bucket is no longer when it is in a horizontal, than in a vertical position" is often overlooked when amateur road builders are considering the advisability of making a diversion.

The accumulating losses due to faulty location are usually not considered by unskilled road builders and too much emphasis is placed on the comparative cost of constructing a road of standard grade, and a so-called passable road, but if the annual production of grain in the area tributary to that particular road were computed and an estimate made of the total annual loss due to the small loads necessitated by excessive grades, it would be found that funds expended in securing a suitable grade, would be a splendid investment on the part of the community. All funds expended on honestly performed, intelligently directed road improvements will indirectly pay large dividends, but in no case are the results more evident to the average layman, than in the case of grade reduction.

Apart from the matter of grade there are many other factors to be considered in the location of road diversions, one of the most important of these is directness of route. When a side hill road is located up the slope of a river valley to give access to a bridge or ferry, considerable emphasis should be placed on endeavoring to secure a route which will gain the top of the slope at or near the surveyed road allowance forming the principal traffic route in that district. Numerous diversions are required in this province to provide roadways across deep ravines which traverse the surveyed road allowances. These crossings can generally be secured with the least loss in directness, by diverting on the up-stream side of the road allowance, thereby benefitting by the natural rise in the elevation of the ravine bed. The writer once observed a road diversion constructed on the down stream side of the road allowance at a point where it crossed a ravine having a natural fall of three per cent, a few measurements showed that the total distance of side hill roadway necessary to obtain a crossing at seven per cent grade was 1368 ft, whereas if the diversion had been made on the up stream side of the road allowance a crossing at the same per cent grade could have been obtained with a total distance of 795 ft. i.e. the crossing on the up stream side would have been forty per cent shorter than the roadway as constructed.

Another important feature to be considered in the location of a road diversion is the providing of a clear sight line of sufficient length to minimize the possibility of accidents. This feature of road location has increased greatly in importance, due to the general use of motor drawn vehicles which travel at a high rate of speed. The level nature of a large portion of this province and the absence of foliage greatly reduces the danger of collision on our highways, but in the case of curves on side hill grades there is considerable danger unless the roadway is widened, reduced in grade, protected by fencing and so located as to give a sight line of sufficient length to enable the driver of a motor car to take reasonable precautions for safety. Two motor cars travelling at 15 miles per hour, approach each other at the rate of 44 ft. per sec. hence a sight line of 220 ft. is required if we assume that 5 seconds is the minimum length of time in which a car travelling at that speed can be brought to a full stop. The majority of sharp curves found in this Province are on grades of from five to seven per cent, consequently it most frequently happens that the ascending vehicle has a velocity of not more than 8 or 10 miles per hour and the danger of collision is therefore reduced. To provide for contingencies such as reckless drivers, slippery road surfaces and imperfect brakes, the writer is of the opinion that a sight line of at least 250 ft. should always be provided. Saskatchewan is fortunate in that most of its road improvement work has been undertaken subsequent to the advent of self propelled vehicles, consequently provision has been made for this class of traffic, whereas in some of the oldest provinces in Canada, it has been

necessary to remodel a large portion of the rural highways in order to meet the changed conditions.

It is impossible in this article to elaborate on each of the considerations affecting the location of a road diversion, but the most essential can be briefly summarized as follows:

(1) The maximum permissible grade and direction of heaviest traffic.
(2) Directness of route.
(3) Cost of construction, including cost of culverts and bridges.
(4) Elimination of danger points (length of sight).
(5) Direction of prevailing winds (winter traffic).
(6) Soil conditions, geological formation and facility for proper drainage.
(7) The probability of the road after improvements becoming a section of a provincial highway system.

Method of Locating Side Hill Grade.

Most of the road diversions in this Province are for the purpose of avoiding deep sloughs or excessively steep hills, gaining access to satisfactory bridge sites, and obtaining crossings of deep ravines and river valleys at suitable grades. In avoiding deep sloughs, or providing suitable approaches to bridge sites across creeks which are only slightly below the level of the surrounding country, no particular difficulties are encountered, but in obtaining the best possible crossing in the case of a deep ravine or river valley, there is considerable scope for the highway engineer to utilize his training and experience. The side hill grade affords in many cases the only practical way of obtaining a crossing at such locations with a permissible grade, and the method of locating side hill grades adopted by the writer shall now be briefly described.

Having made a thorough exploration of the banks of the valley across which a roadway is required, and having clearly grasped the relative positions of existing roads on either side to the most suitable crossing at the bottom of the valley, a tentative location is decided upon, bearing in mind the several considerations already mentioned. The grade which is obtainable on this route has been fairly accurately determined while walking over the ground during the preliminary exploration of the slopes, but if the course is reasonably straight a few readings with the clinometer will serve to verify or modify the original estimate of the grade percentage which can be secured.

When a reasonably accurate estimate of the obtainable grade has been made, a trial line is staked out on the ground by means of the clinometer. In the absence of bush the only assistance required for this work is a rodman; and the entire equipment consists of the clinometer, two pickets equal in length to the height-of-eye of the observer, a bundle of small stakes about 15 inches in length, and a hand axe. The clinometer is set and clamped at an angle corresponding to the estimated grade percentage, and starting from a desirable and apparently feasible point of landing at the crest of the valley, the rodman proceeds down the slope carrying one picket and the bundle of stakes. Having proceeded a distance of not more than 100 ft. the rodman holds the picket in a vertical position, and moves in a transverse direction up and down the slope until the clinometer held firmly on top of rear picket shows the cross wire cutting the top of the rodman's picket. The point at the base of forward picket is then a point on the grade and is preserved by means of a stake. The observer then moves ahead to this stake, while the rodman is proceeding still farther down the slope and the process is repeated. Several points on the grade line could often be located from one station, but the writer has found it advisable to follow closely behind the rodman in order to see in advance any obstacles to construction which it is necessary to avoid.

It will frequently happen that on approaching the bottom of the valley, it becomes evident that one is unable to reach the desired objective, at the grade provisionally adopted. The process is then reversed and by using good judgment in the correction of the grade percentage, a grade line can be run up the slope from the required point in the valley, which will reach the summit at or near the desired outlet.

There are several complications that arise in connection with the location of side hill grades, such as the crossing of tributary ravines without loss of height and at a reasonable cost, and the providing for a reduction of grade on sharp curves, but these difficulties are easily overcome by the experienced road builder and a very satisfactory road location can be secured by means of the clinometer, with a great saving in time and energy as compared with locating the same length of roadway by means of a transit. The grade line located in the manner above described is not to be considered as the centre line of the roadway except on straight even slopes where the transverse cross-section of the finished roadway would give a balance between cut and fill. On all sharp curves the grade line is to be taken as indicating only the elevation of the finished roadway, which is to be constructed largely by excavation, or largely by embankment, according as the requirements for correction of alignment may determine.

The above described method of locating side hill grades is, with certain modifications, followed by several of the highway engineers in this Province, and the credit of introducing this method into Saskatchewan is due to W. T. Thompson, a member of our society and one of the efficient pioneer road-builders of Western Canada.

Drainage.

No subject involved in the construction or maintenance of an earth road is of as great importance as that of drainage, consequently, as the usual cross-sections of roadways in cuts, fills and side-hill grades together with their methods of construction are fairly well standardized, we shall confine elaboration on construction to that feature which is common to all cross-sections, namely, provision for drainage.

Water is the natural enemy of any road, and may be considered as the most destructive agent that is encountered in road construction or maintenance. Roads which are excellent during the summer season, lose every semblance of that condition during the early spring; simply because earth readily absorbs water; hence, the

provision for drainage must be complete if the roadway is to be readily kept in good condition.

There are two distinct phases of the road drainage problem: one is taking care of the surface water, getting it quickly into the side ditches and carried away to natural drainage channels, and is known as surface drainage; the other relates to removing the water out of wet subsoils and is known as Sub-drainage.

Surface Drainage.

Surface drainage has received fairly general attention during recent years and, as far as the prairie provinces are concerned, it is of more importance than sub-drainage for the following reasons:—

First: Because of climatic conditions and the comparatively small areas of wet or marshy land requiring sub-drainage; and

Second: Because the topographical features of these provinces are such that in many districts the natural water courses are far apart, with resulting large catchment basins, hence provision has to be made for a considerable accumulation of water in side ditches, and for correspondingly large culverts.

Transverse surface drainage does not depend entirely on the crown of the road surface, but also on the longitudinal slope of the road. This is a factor in road construction that is frequently overlooked, but an examination of road surfaces after a heavy rain fall will show that the road on a slope under similar conditions of soil and crown, is not affected to the same depth as the level road. For this reason, and to facilitate the provision for side drainage, long, absolutely level stretches of roadway should be avoided wherever practicable,—for example in the case of a roadway constructed around the base of a hill, it often occurs that the roadway could be constructed at the same elevation for a considerable distance, but as there must be a slope to the side ditch to enable the water to run off, the ditch would be too shallow at the centre of the level section and too deep at the ends where the water is to be discharged. In such cases it is preferable to make sufficient inclination in the road surface so that the ditches may be of uniform depth throughout. This method not only simplifies the construction of the ditch, but also assists in the transverse drainage of the road. In a low area subject to flooding a nearly level roadway is necessary to minimize the cost of construction, but even a slight grade would assist in a more prompt discharge of surface water: There is little or no danger of water running down the surface of a properly crowned road and causing serious erosion, unless the longitudinal grade exceeds four per cent.

The transverse slope of road surface should vary with the class of soil, but the average slope adopted in this province is 1 in 12, i.e., for a 16 ft. road surface the height of crown at centre of roadway would be 8 inches, this crown height usually decreases slightly as an embankment becomes consolidated, but it is readily renewed by use of the road drag or grader. On side hill grades the general method adopted throughout the province has been to slope the entire road surface towards the hill at a slope of 1 to 12. This method results in more water being on the road surface for a longer period than in the case of an embankment where the slope is from the centre towards the sides, and it is the opinion of the writer that this type of cross-section for *earth* roads properly belongs to *sharp* curves and *heavy* side hill cuts where the slope of the road bed adds somewhat to the safety of the route. On comparatively straight side hill grades where the natural slope of the hill is not more than twenty per cent, part of the surface water could advantageously be discharged over the embankment by the crowning of the road bed.

The method of constructing an embankment has a great effect on its ability to prevent surface water penetrating to any considerable depth. Material should be deposited evenly over the entire width of the embankment and the centre should be kept higher than the sides at all stages, so that there is a tendency, at any points in the embankment, for water to drain towards the sides. When the centre of an embankment is built up to the required elevation and material deposited over the sides until the necessary width is obtained, the earth in the sides of the embankment is not consolidated during construction and readily absorbs large quantities of surface water.

The second stage of surface drainage is the conveying of water discharged from road surface to a natural water course, this is accomplished by means of side ditches which should, as far as possible, be of such a cross-section that they can be formed and maintained by road machines. Side ditches are always required in the case of a cut, a side hill grade, or turnpiked road; but, in the case of a roadway which is constructed well above the natural surface of the ground, side ditches are not essential for surface drainage, although often required for sub-drainage. The slope of side ditches should not be less than 0.4 per cent if such a slope is readily obtainable, and they should be constructed with all due regard to safety: The existence of deep ditches with almost perpendicular slopes close to the toe of embankment, has caused many serious accidents.

Sub-Surface Drainage.

A water-soaked sub-grade makes it impossible to maintain a satisfactory road surface, just as quicksand under a foundation renders the structure unstable. The lack of proper sub-drainage is the direct cause of the impassable condition of some of our roads when the frost is coming out in the spring. Had the excess moisture been drained out of the road bed the heaving of the road surface by frost would not have occurred.

Whenever water stands in the subsoil at a depth of 3 ft. or less, and often at a greater depth than this, the earth between the water level and the road bed absorbs water by capillary attraction to a greater or less degree depending upon the nature of the soil. The sub-grade of the road is thus kept in a moist condition and excess moisture applied to the surface of the road in the form of rain or melting snow will often cause excessive depths of mud. Proper underdrains, by removing excess moisture as fast as it appears, keep the subsoil dry, and as dry roads are almost always good roads, the importance of subdrainage is apparent. The cases where subdrainage has been undertaken in this province are confined to a few deep cuts where the ground appears to boil up in the

spring, numerous muskegs, and embankments on wet marshy subsoil. In the case of deep cuts, it is usually sufficient to dig a trench on the up-hill side of roadway, to a depth of at least 3 ft. or until the water-bearing strata is reached. The trench which must be dug to a grade can then be filled in with fagots or rock; at some locations it will be necessary to dig a ditch on both sides of the roadway to effectively drain the subgrade. In the case of muskegs a deep open ditch on both sides of the roadway is required.

Where an embankment has been constructed across an alkaline flat or lake bottom, the bearing capacity of the water-soaked subsoil is not sufficient to carry the weight of the embankment and the live loads passing over it, with the result that the road surface assumes a rolling appearance, and when heavy rains soften the surface of the road to a considerable distance the earth loses its arching tendency and the filled in material often sinks into the subsoil causing depressions in the road to such an extent that moisture reaches the road surface by capillary action and the result is an impassable roadway. The writer has in mind an embankment approximately one mile long across an old lake bottom. This road is subject to extremely heavy traffic, and the rolling, and subsequent impassable condition already described takes place annually. Large amounts are expended in an endeavour to repair this road by filling in the depressions, but the local authorities have not to date undertaken to remove the cause of the trouble, i.e., excess water from the subsoil, even though they have received engineering advice from several sources to the effect that drainage is the only permanent solution.

Culverts.

An important feature in connection with drainage is the providing of sufficient, and suitable culverts. Water should not be carried in a side ditch beyond a point where it can be readily discharged off the right of way. When such a drainage point is reached the water must be taken through a culvert from the upper to the lower side of the road, and turned into the natural drainage channel. The culvert must be of sufficient size to carry all possible volumes of water delivered to them by the side ditch, and in cases where the natural drainage channel traverses the road, provision must also be made for the maximum discharge of that channel. The maximum rainfall and the area of the catchment basin have to be considered in determining the size of culvert required. Having obtained the necessary data, the capacity of the culvert required can readily be obtained by means of the following formula:—

Run-off in cu. ft. per sec.—Inches of rainfall x acreage x 0.042. In applying this formula in Saskatchewan the writer assumes the maximum rainfall to be 1 inch in 24 hours, and in determining the diameter of culvert required for a given discharge in cu. ft. per sec. the slope of the culvert is taken as 1 percent.

On side hill grades the water from the ditch should be discharged over the embankment at frequent intervals. As the longitudinal slope of the roadway increases, the space between culverts should be lessened. These culverts should not be placed at right angles to the centre line of the roadway, but should be at an angle which will carry the water in a down hill direction, this gives a more direct entrance for the water from the side ditches, and consequently prevents sediment being deposited at the eddy otherwise formed. The entrance to the culverts on side hill grades should be cobbled and the continuance of water down the ditch past a culvert should effectually be prevented. In the case of a high embankment the slope should be rip-rapped below the outlet of the culvert to prevent erosion.

Culverts can be divided into three general classes, sub-divided as follows:—

1. Pipe Culverts:—
   - (a) Vitrified Tile
   - (b) Cast iron
   - (c) Corrugated iron
   - (d) Concrete.
2. Box Culverts:—
   - (a) Stone
   - (b) Concrete
   - (c) Wood.
3. Arch Culverts:—
   - (a) Concrete, plain and reinforced.
   - (b) Masonry.
   - (c) Brick.

The types of culverts most generally used in Saskatchewan are pipe culverts of vitrified tile and corrugated iron; and box culverts of wood and concrete, but during the past few years the majority of culverts installed were of corrugated iron. The favorable features of corrugated iron culverts are their portability and the facility of their installation, but it is a serious mistake to suppose that all that is necessary to do when installing one of these culverts, is to roll it in place and cover with sods, stones, brush or any available refuse. These culverts should be placed to at least a one per cent grade on a well prepared bed. Should settlement take place at the joint which frequently exists, leakage may occur and eventually undermine the culvert and roadway. The presence of stones, sods, etc. against the sides of the corrugated surface leave voids through which the water may pass when the culvert is discharging almost to capacity, and the result is the washing away of material and the consequent collapse of the road surface.

Corrugated iron culverts have not been in general use in this Province for more than ten years, consequently their durability in various kinds of soil has not been determined, but the writer has recently examined one of these culverts which was installed in the fall of 1913 in a fill across an alkaline lake, and found that the culvert was so badly corroded that the corrugation could readily be flattened out with an ordinary nail hammer. A close examination showed that the corrosion was confined to that surface of the culvert which was in contact with the material in the fill, and an analysis of this material showed that Sulphates of Calcium, Magnesium and Sodium were present. The dangerous element in the soil was Sodium Sulphate which attacked the zinc galvanized surface, and the unprotected iron simply rusted away.

A simple test whereby the presence of injurious sulphates in the soil can be detected is as follows:—

Take a small sample of the soil, add distilled water and filter, transfer the filtrate to a test tube and add zinc filings, let stand for a short time, then filter. Transfer a few drops of this filtrate to a plaster tablet and add one or two drops of one percent solution of cobalt nitrate, apply heat with blow pipe. A green color indicates zinc, and shows that the filtrate from the soil has attacked the zinc filings and will therefore destroy the protective coating of metal culverts.

The present price of corrugated iron culverts is about fifty per cent in advance of the pre-war quotations, consequently several municipalities in this Province are commencing to build concrete pipe culverts. The writer is indebted to S. A. Button, district engineer of the Good Roads Board of Manitoba for details of the cost of concrete pipe of various diameters constructed by the Rural Municipality of Wallace, Manitoba. From the information furnished, it is evident that at a central plant concrete pipe can be constructed at about a quarter of the cost of corrugated iron pipe of equal diameter. Allowing for the difference in transportation charges, there would still be a substantial margin in favor of concrete pipe.

Maintenance.

The keeping of an earth road in good condition requires constant attention, and our rural roads will immediately show a very much improved condition when this fact is recognized by municipal authorities. The most approved method of maintaining an earth road is by dragging, but it must not be expected that dragging will prevent mud, the most that can be accomplished is to have less mud. Earth roads can be systematically dragged throughout an entire season at a cost of from $10 to $15 per mile, but the dragging of an earth road is not all the maintenance required, for although the surface may be well crowned and free from ruts, still the road may be very quickly rendered impassable if the ditches and culverts are obstructed. Many of the culverts in our roads are choked with sediment, tumbling mustard, etc. and the ditches overgrown with weeds and partially or entirely filled with material washed from the adjoining slopes. The use of a blade grader on an earth road, once every two or three years is often erroneously considered to be adequate maintenance, but if sods, weeds and other refuse are deposited and left on the centre of the roadway the results are more disastrous than beneficial.

In conclusion, the writer wishes to emphasize, that engineering supervision of construction, and constant attention to maintenance, are the principal factors necessary to make of an earth road a satisfactory highway.

The second paper on the programme, " Road Work in Manitoba," by M. A. Lyons, M.E.I.C., chief engineer, Highway Commission, Manitoba, followed. It was arranged that the papers be read in sequence, in accordance with the arrangement made at the Toronto meeting, allowing for discussion of the subject after the reading of the papers.

Road Work in Manitoba.

General Provincial Policy.

Road improvement in Manitoba is being carried on under " The Good Roads Act ". This Act was passed in 1914 and provided for the borrowing of two and one-half million dollars for the construction of main market roads and provincial highways. On main market roads assistance is given by the Provincial Government to the extent of one-third (1/3) of the cost of earth roads and one-half the cost of gravel roads, and on provincial highways two-thirds of the cost is paid by the Government. On all so called permanent structures, such as those of concrete, masonry or steel on Good Roads, payment of one-half the cost is made, and on wooden structures one-third the cost.

In 1915 an amendment was made whereby assistance is given in the building of bridges not on a Good Roads System; permanent structures costing $200.00 or over, one-half of the cost, and on wooden bridges costing $500.00 or over one-third of the cost.

Organization.

"The Good Roads Act" is administered by the Good Roads Board, consisting of three members of which the Highway Commissioner is Chairman. Attached to the Board are a " chief engineer and such engineers, surveyors, inspectors, clerks " etc., as are necessary. The engineering staff is divided into two branches, bridge engineers and road engineers. The work of the bridge engineers extends over the whole province, but for the road work the Province is divided into districts and a District Engineer has charge of all road work and general supervision of bridge work in his district. Where ever such assistance is needed the district engineer has an assistant engineer. Where any large scheme of road improvement is being carried out in a municipality, that municipality is required to put a resident engineer on the work. The expenses of this engineer are charged against the cost of the road and he works under the direction of the Good Roads District Engineer. On bridge work the municipality is required to have a competent inspector on the work. The expenses of this inspector are charged against the cost of the bridge. This inspector is under the general supervision of the district engineer and the direct supervision of the bridge engineer in charge of this particular bridge. All engineers and inspectors are required to report weekly to the Winnipeg office.

Application of the Act.

The primary intention of " The Good Roads Act " is to assist the municipalities in developing and improving a system of main market roads. To this end the municipal authorities desiring assistance under the Act must first lay out a system of market roads in their municipality and submit this system to the Good Roads Board for approval. The Board then deputes an engineer to examine the scheme and report on its serviceability and probable cost. After the system has been accepted by the Good Roads Board, and by the Government by Order-in-Council, the municipality is at liberty to carry out the construction of the scheme with the expectation of receiving assistance from the Government.

The Good Roads Act provides three ways of financing this roadwork: by current revenue, by special rate or by debenture issue. If by the last mentioned method, the road system and debenture issue must be approved by the ratepayers before any further steps can be taken.

Up to the present 12 municipalities have taken advantage of the debenture method for construction of roads. All works are to be done by contract unless another method is approved of by the Good Roads Board. All work must be carried out under the direction of a Good Roads engineer who must verify that all works done are according to plans and specifications. To obtain the payment of the Government's portion the secretary treasurer of the municipality is required to send in a statement of the cost of the work accompanied with necessary vouchers and a statutory declaration that the statement is correct.

Carrying out of the work.

In the bridge work about ninety-five per cent of the work is done under contract and about seventy-five per cent of the road work. While in a number of cases roads constructed by day work with local labor has been cheaper in first cost, when the finished appearance of the work is considered the contract work is, in ninety-five per cent of the cases, more satisfactory and any slight extra cost is justified. The municipal authorities are becoming more favorable each year to let work by contract even at a slightly higher cost. Having work done by contract does not always insure a good piece of work but a class of contractors is being developed in Manitoba who will turn out good work and as this method of doing work is carried on, the difficulty of securing a satisfactorily finished road will become smaller. This year's contract price varies from fifteen cents per cubic yard to thirty-eight cents, depending on the nature of the soil, and the type of the contractor. Some of the small contractors, doing perhaps one or two miles of road, and who only expect to work for a short while in the farmers' slack time in summer, do work as low as fifteen cents per yard, where all the work is side-work. A contract for nearly 10 miles of gravel road, where there were old ditches, but little overhaul, was let for twenty eight and a half cents per cubic yard. A contract for twenty-four miles in Sifton Municipality was let at thirty cents per cubic yard. About five miles of this contract will be quite wet and another two or three miles very sandy; some parts there will be considerable end haul, mostly within the free haul limit. In another municipality the contract was let for twenty-seven miles at thirty-one cents. A large amount of this was end haul coming just within the free haul limit. The free haul is in general one hundred (100) feet with one per cent station year over haul.

In many portions of Manitoba the scraper is about the only way of building roads. In some places, however, the push grader can be used. One municipality, which intends to construct about two hundred miles under "The Good Roads Act," and which has already passed a debenture by-law for $171,960.00 has purchased a 60-80 Twin City Traction engine and two 12-foot blade Russell graders. The district engineer in charge of this work is keeping careful records of the cost of the various items in this work and we hope to have some valuable data in this connection for this year's report.

Material.

The soils of Manitoba vary from the heavy gumbo to pure sand. The gumbo, when dry and properly dragged, makes an excellent road, but when soaked with water is almost impassable. Wonders can be worked with this class of soil through good side drainage, a good crown and above all, a properly maintained surface. Gravel surfaces have been built on some gumbo roads and about twelve inches of gravel are required before the surface is satisfactory. The first coat of four inches will probably disappear entirely; the second coat of three inches will leave its mark; with the third coat of three inches, it begins to look like a gravel road, and two inches more of fine material makes a very good surface. Unfortunately, in much of the gumbo region gravel is scarce. On one of the main roads, on which grading has just been completed, it is intended to construct a sand clay surface, using sand from the Assiniboine river which closely follows the road. In the western portions of the Province about five inches of gravel makes an excellent road. This is applied in two coats; one of three inches and one of two inches. In some of the sandy country a good road has been built by the addition of about six inches of clay and again covering the clay with an inch or two of sand. In some parts of the south-west the light drifting sand has been treated by working straw into the grade and when this has been thoroughly mixed in, to cover the surface with gravel. The gravel in this district has a large amount of soft limestone which cements quickly under the traffic and moisture.

Gravel is not so plentiful in Manitoba that the Engineer can pick and choose. He takes what he can get and is generally pretty well pleased to find any within reasonable hauling distance.

Engineering.

In the construction of roads great care is taken to provide suitable side drainage. This is sometimes quite a difficult task, especially in the Red River Valley where the country is quite level. Deep ditches along the road are being avoided whenever possible but this is not always possible without going on private land or making long offtakes. The only proper drainage of country is along natural drainage lines, whether for farm drainage or road drainage. But in Manitoba to attempt to open up drains across fields would often lead to unplesant consequences. Therefore, the road allowances carry many ditches which should not be there and the safeness of the road is endangered. In the cross section of the road we are eliminating a berm wherever possible. We give the road a crown of one inch to the foot and a slope of four or five to one to the ditch, and about three to one on the outside of the ditch. This makes a road which is pleasing in appearance, safe for nervous horses, easy to maintain, and has good transverse drainage. Our ordinary market roads are eighteen feet wide and more important roads are twenty to twenty-four feet wide. We try to keep grades down to five per cent, but it is not always economical to do this, so that grades as high as seven per cent, are in use and in a few cases ten per cent. Culverts are made with a minimum length of twenty-four feet between headwalls.

Maintenance.

The Good Roads Act provides that all roads built under the Act must be satisfactorily maintained by the municipality. If this is not done the municipal commissioner has the power to have it done and assess the cost of the work to the municipality. In nearly every case, however, the municipalities are taking great interest in the maintenance of roads. In many places Good Roads Dragging Districts are formed and prizes offered for the best maintained roads in the district. This year the Provincial Government has offered two splendid prizes for competition in road maintenance; one for gravel roads and one for earth. The Government also will pay to a municipality $3.25 per mile per season, (up to two hundred and fifty dollars ($250.00) per municipality) for any road properly maintained throughout the season. The Government also provides the services of an expert dragman and grader man whose services are free to any municipality for demonstration in dragging or push grader work. For earth roads the plank-drag or steel drag is used, generally the latter. While the plank-drag probably gives better results if used at the proper time, in most cases the road is not dragged until it has pretty well dried out, in which case the steel drag gives better results. For gravel roads we have found the Minnesota planer to be by far the most satisfactory implement for maintaining a smooth surface on this type of road.

At present about fifty municipalities are building roads under "The Good Roads Act" and nineteen hundred miles have been accepted by the Good Roads Board. Three hundred and sixty-five miles of earth roads and one hundred and ninety-one miles of gravel roads have been constructed up to the end of 1917 and one hundred and ninety miles are under construction. One hundred and fifty concrete structures; thirty-one steel structures and forty-nine wooden structures have been built up to the end of 1917. This year about sixty-five concrete structures and fourteen wooden structures will be built. Up to the end of 1917 the Government had paid $680,000 as its share of work performed under "The Good Roads Act."

J. D. Robertson, A.M.E.I.C., continued the programme by reading his paper "Experience in Road Construction in Alberta."

Experience in Road Construction in Alberta.

Our experience with regard to the improvement of rural roads of sand, gravel etc., has convinced us, fully, that we cannot fix hard and fast methods of construction. Conditions vary so much they control the method that must be followed to get results. However, there are a few general principles that we endeavor to follow.

The first, and most important, is to get the water off, and second, after the road is constructed, to keep it maintained.

The prevailing defect in earth roads is poor drainage which should receive first consideration. To obtain best results we believe the side ditches should not be over twenty-four feet, centre to centre, and the roadway sixteen feet from between shoulders with a crown of one inch to the foot. There is often strong objection raised to this width as being too narrow. However, we find that it is much easier to keep a narrow road in shape for traffic.

Although the grade line of a road is very important, and we endeavor at all times to have a maximum grade of seven per cent, many of our foremen are always anxious and working to obtain easier grades without any thought of the grade line of the side ditches, especially where the country is slightly rolling and the work is being done with a blade grader they take great care that the side ditches are carried through with a uniform depth. The result is that the bottom of the side ditch is the same depth in the depression as on the knoll. This is pleasing to the eye when the work is finished, but the result is self evident. After every fall of rain these ditches, which were supposed to be a benefit to the road are a detriment, instead of getting the water away, they act as a reservoir to hold the water until it either seeps into the road or evaporates.

Another point that is given careful consideration, is the placing of culverts. We often find culverts are not placed at the point where they would do most good. The proper point may be low, damp, and disagreeable to work in, whereas a few feet either direction it is better footing and we find the latter point is often chosen, with damaging results.

We find it very necessary to have off-take ditches to carry the water away from the side ditches, and believe there cannot be too many of these, as it is, without a doubt, a poor policy to carry water along the side of the road any farther than is absolutely necessary. The quicker it is taken away, the less chance of seeping into the road.

Too much attention cannot be paid to the construction of culverts, and off-take ditches, and they should be considered together, and not separately. Where an off-take ditch is necessary, a culvert or culverts are also very likely needed. Where a road runs across the general slope of the country, frequent culverts are necessary, otherwise the water is carried far too great a distance along the upper side of the road. If this is done it naturally follows that a certain amount of the water seeps into the road, hence the necessity of a culvert across the road wherever necessary, and an off-take ditch to carry the water away from the ditch along the lower side of the road.

In passing, I might mention the necessity for having culverts large enough. If a culvert is so small that it becomes completely full with the first thaw in the spring, it is very liable to freeze solid, with the result that it will be full of ice just when it is most needed to prevent the flow of melting snow from cutting away the grade. Whereas if the culvert were a little larger this might not happen.

In connection with constructing a grade across a slough, in which there is open water, the general desire of a great many of our inspectors is to build a grade across the slough, without any attempt at trying to get the water away. Of course, we realize there are often many objections to this. A ditch might easily be put in that would take all the water away but it might mean an open ditch through a grain field, which is not a desirable thing to have,

and almost without exception it is rather difficult to convince a farmer that the benefit of having a good road, will off-set any damage to his field; He being a human, naturally believes that it would do less damage to his neighbor if it could only be carried the other direction. As we do not wish to establish a precedent of putting in closed drains, you can therefore realize our difficulty. The inspector who has talked with the owner of the land through which the ditch should be constructed and heard his tale of woe, recommends that a grade can be maintained through the slough for less money than by drainage and grading, and after the grade has been under water, and the road impassable every spring for a few years, we finally have to put the ditch through where it should have been in the first place, and drain the slough, or at least control the height of water. There are such places, however, that it is not possible to drain, in which case we always aim to have the grade at least two feet above the high water level.

Before going into the question of maintenance, I wish to mention a few very common practices which make it rather difficult to keep our roads maintained. The pasturing of cattle on the roads does a great deal of damage to the side ditches, also to the approaches to bridges or culverts, especially if they go to these points for water. Of course, in certain parts of the country, where the land is unfenced, it is rather difficult to prevent such damage but under these conditions the damage is not great in comparison to other sections where the road allowance is fenced on both sides, and is considered a very convenient public pasture.

We also frequently find that when entrances to private property are opened the side ditches are filled with poles, straw or manure which forms a dam.

Constant maintenance of an earth road is absolutely necessary, and is much less expensive than reconstructing it every two or three years. In the case where a road is properly maintained, it is available for traffic the year around, but where it is constructed and then forgotten about for a few years, the usual result is that it is hadly fit to carry traffic during that period and then has to be reconstructed. Our method of maintenance is by going over the ground with a drag after every rain. The result obtained depends almost entirely on whether or not it is dragged at the proper time. It should not be dragged when too wet or should not be allowed to get too dry and bake. An earth road that is drained and crowned, as it should be, can be kept in good condition for traffic the year around as far as injury from moisture is concerned if dragged at the proper time after every rain. There is one factor, however, that we have to consider and that is a long dry period. It is rather difficult to do much with an earth road during long periods of dry weather. Our roads are kept in much better condition with frequent rains.

We try to divide the roads into sections of about ten miles each and employ someone living about the centre of the section to work five miles each way. Of course the length of the section depends on whom we get to do the work, as some of our men look after as much as twenty miles but with this distance to travel they very often cannot get over it all when they should. But with a ten mile section, and living in the centre, a man should keep the road in good condition. If the soil is lighter in one direction, it makes an ideal condition, he goes over the light end first which dries quicker and then over the heavier soil. Under normal conditions we have had this work done for seventy-five cents per mile for each time the road is dragged, now the cost is higher.

We are now coming to our greatest problem, the one which is the cause of more complaints than all others together, especially from the man who uses a motor car, and that is our difficulty to obtain the services of men to drag our roads, who will take an interest in the work, who will do it at the proper time, and not wait days until they have nothing else to do, and who will stay off the road when it is so hard and dry they are wasting time and money.

In conclusion I wish to say that in Alberta, at least, owing to the rapid development of the Province, I believe that for years to come we will have to be satisfied with earth roads; with a little surface of sand on clay where necessary, or clay on sand where the sand will not carry traffic during dry weather, or gravel surfacing where such material is available. However, in Alberta, as yet, we have done very little of even this class of work. Almost all our roads are constructed and top dressed with material from the side ditches or by balancing cuts and fills.

Following the above paper, W. M. Stewart, A.M.E.I.C., read one on the subject of "The Planning of a System of Rural Highways under Conditions existing in the Province of Saskatchewan."

The Planning of a System of Rural Highways under Conditions Existing in Province of Saskatchewan.

In all rural districts the working out and adoption of a definite scheme for road development is essential if there is to be efficient service and economy in road development and this is particularly true in the Western Provinces, where development is still comparatively in its initial stages.

The first step in working out a rural road development scheme should be the planning of a system of roads, classifying the roads according to the traffic they are to carry and drawing up a plan showing the system of roads adopted.

Roads in the Province of Saskatchewan are usually divided into four classes, viz:

Provincial roads: those carrying a large proportion of through traffic, originating outside the district under consideration;

Main market roads: those carrying a considerable concentration of market traffic, originating principally in the district;

Main feeder roads: those serving as the principal feeders to the provincial or main market roads;

And local roads: those carrying only, or but little more than, the traffic originating upon the farms actually adjacent to the road.

The first class, the provincial roads, are not usually separately defined at present in Saskatchewan, as it is understood to be the policy of the Provincial Highways Department to leave the defining of these roads in abeyance and in the future, as the main market road systems, are developed, to then work out a system of provincial roads by linking up the various main market roads. If it were possible to at present define a system of Provincial Highways it would be a considerable advantage in planning highway systems and probably save unnecessary duplication of main roads in the future. It is recognized, however, that in the present stage of development the defining of a system of Provincial Highways which would satisfactorily meet future conditions, would be very difficult, if not impossible, and as the class of road built for some time to come will be largely dirt roads, the objection to the policy is not a very serious one.

In locating the "Main Market" roads the purpose is to so locate them as to serve the market traffic in the districts tributary to various marketing points to the best advantage and to link up one with another to provide for through traffic.

The "Main Feeder" roads are located so as to serve those areas which are somewhat remote from the "Main Market" roads.

The "Local" roads constitute the balance of the roads in the district.

A method which has been found to work out very satisfactorily in planning a system of rural highways under Saskatchewan conditions, is to first draw up a preliminary system of roads, based upon the readily available information as to existing topographical and settlement conditions and then use the preliminary system so worked out as a basis for the detailed field examination and final determination of the system of roads.

In older communities, where many main routes of travel are well established and difficult to change this method might not be satisfactory, but in Saskatchewan, where there is more freedom of choice in deciding upon main road locations and the problem is principally to decide what would be the most advantageous main road location and to direct traffic into that route, the method works out very satisfactorily.

When working out the preliminary road system, a plan is first prepared of the district under consideration and intimately related adjacent districts, showing all railroads, marketing points, public gathering places and the principal topographical features, information in regard to which is readily available. It is also usually possible to readily obtain fairly accurate information as to density of settlement, the amount and class of production in the settled areas and the class of the land, both vacant and settled. From this information a fairly accurate estimate of the existing traffic may be made and a conclusion arrived at as to probable future development.

Based upon the information so gathered the district is divided into sub-districts, each of which is naturally tributary to a marketing point. With the sub-districts decided upon the problem then is to locate the main market and main feeder roads so as to best serve the market traffic and to link up these roads to provide for through traffic. In working out their location no general rules can be made applicable and each case must be approached as a separate problem. The main roads must generally follow the existing road allowances, or the section or quarter section boundaries, except for minor diversions to avoid serious obstacles. In some cases the most advantageous location for a main market road is a road having a general diagonal direction across the sub-district, but following the regular road allowances. Diagonal roads, cutting across country, while possessing many advantages, cannot usually be adopted, where the system of land subdivision is rectangular in form, as in Saskatchewan, owing to the resulting waste of land and inconvenience to farming operations. Existing railroad lines, or peculiarly suitable topographical conditions in some cases make possible the adoption of diagonal roads, and in such cases they are a great advantage.

Usually the aim is to so plan the main road system that no quarter section of land in the district is more than three miles (following the regular road allowances) from a main market or main feeder road.

The preliminary road system so worked out is then used as a basis for the detailed field examination, which consists of checking up the information already gathered as to existing settlement and production and the class of the land; the examination of the proposed main road locations to determine if the physical features are such as to permit of their development to main road standard at a cost waranted by the traffic to be carried, and also to determine if their location is such as to make them readily accessible to the traffic which they are to serve. The main road system adopted upon the preliminary plan is then amended according to the information so developed in the field examination.

When worked out upon the basis described, the main market and main feeder roads usually comprise from twenty to twenty-five per cent of the total road mileage in the district and (taking the average of the whole district) the average distance of quarter sections from a main market or main feeder road is usually about one and three quarter ($1\frac{3}{4}$) miles.

So far as the writer is aware no traffic census has been taken in Saskatchewan to determine the percentage of the total traffic in any district which is carried by main market or main feeder roads. A fairly close estimate of this percentage may, however, be made by calculating the total mileage which each quarter section is from its market town, by the route which traffic must follow, and in each case noting also the mileage in such total distance which is travelled over main market or main feeder roads. In cases so investigated it was found that the mileage travelled over main market or main feeder roads, in marketing produce, represented from eighty to eighty-three per cent of the total haul.

It is therefore a conservative statement to make when it is said that twenty-five percent of the roads, if properly selected, will carry eighty-five percent of the traffic, for the above estimate has not taken into account at all the through traffic, which is confined almost exclusively to the main roads.

This demonstrates the great advantage resulting from the proper planning of the main road system and of

concentrating as far as possible upon main road construction, and when it is remembered that for economy in construction and efficient service the roads should be built to a standard suitable to the class of traffic to be carried, the necessity for defining the main road system is further emphasized.

Coincident with the defining and adoption of the road system, a scheme for its development should be worked out in order to secure the gradual development from year to year of the system in such a way as to give the greatest service from the available yearly road funds.

Probably the best method of securing this result would be to draw up a tentative programme of yearly construction to be carried out from year to year to the final completion of the system. The programme so adopted would undoubtedly have to be amended from year to year as conditions called for. It would, however, serve as a guide in deciding upon each season's w ork and provide a definite goal to work to. This step, however, is probably more than we can at present expect of our municipal councils and the best we can hope for is the adoption, by municipalities, of " Development By-Laws " as provided for by the new Town Planning & Rural Development Act. Such development by-laws could define in a general way the road policy of the municipality and could specify the standards of construction to be adhered to for various classes of road and could also specify the minimum percentage of the available yearly road funds which must be devoted to Main Road construction and also require that not less than a certain minimum sum per mile of improved road, must each year be set aside and expended for maintenance and repair. Numerous other points could of course be covered in the by-law, but the points mentioned illustrate the manner in which the development by-law could operate to direct development along proper lines.

A number of our Saskatchewan municipalities are as strong financially as many of the communities in the older districts, which have adopted comprehensive road development schemes including surfaced roads of various types, and while road development in the West will be more costly than in most of the older communities, it nevertheless seems reasonable to assume that at no very distant date some of our municipalities, also, will adopt a full scheme of development, including a programme of yearly development and a certain proportion of surfaced roads.

In working out such a scheme of development it is necessary to know:

1st. Those roads the early improvement of which will give the greatest benefit;

2nd. The type of surface which the existing and prospective traffic requires and if the cost of such a surface would be waranted;

3rd. The financial capacity of the municipality.

From a knowledge of the existing settlement and production and the class of the land a fairly accurate estimate can be made of the existing and prospective traffic and based upon these estimates the relative importance of the various roads may be compared; the type of surface necessary to provide a satisfactory road can be deduced; the approximate saving in haulage costs determined and from this a conclusion arrived at as to the type of surface warranted.

In making such an estimate the traffic area for the road under consideration is first determined and information is then gathered as to the area under cultivation, the nature of the products and the class of the land. The average annual area under crop tributary to the road and the average yield per acre will, under Saskatchewan conditions determine with sufficient accuracy the yearly tonnage of the principal market traffic and this information can be supplemented by details as to the tonnage of return haul farm supplies, an approximation as to which can be obtained from the town merchants.

One way of considering the traffic is to divide the total tonnage by the number of hauling days per year, (usually taken at 300,) which gives the tons per day; multiplying this by the average haul gives the ton miles per day and dividing by the total length of the road gives the daily average tonnage per mile hauled over the entire road and the tonnage hauled is the most satisfactory basis for comparing the relative importance of market roads and from which to determine the economic value of a road. In this connection it may be noted that the average haul is usually from sixty-five to seventy per cent of the maximum haul.

As to the weight of the yield per acre of cultivated land: This can usually be determined from a knowledge of local conditions. The U.S. census returns show an approximate average product of 322 pounds per acre of farm land and the average yield per acre on improved farm land in crops was 1,674 pounds. The average weight per acre of forest products on unimproved, timbered, farm land was 122 pounds.

From such an estimate of the volume and class of traffic to be provided for, a comparison may be made of the relative importance of various roads and the types of road surface which will satisfactorily carry the traffic may be determined.

The problem is then narrowed down to the selecting of that one of the various satisfactory types of road surface which will show the least total annual cost. The total annual cost of a road being annual interest on first cost, annual maintenance and repair and a yearly amount necessary to be set aside to create a sinking fund which will renew the surface when it wears out, or in the case of roads built by bond issue,will retire the bonds when they fall due.

If then investigation shows the necessary funds are available and that the improvement is warranted by the benefits accruing, the type of road so determined upon should be adopted. If the necessary funds are not available a compromise will have to be made and a type of road surface of less cost selected and traffic will have to accomodate itself to a road which will be more or less unsatisfactory during certain seasons of the year.

In some communities it has been made a general rule that " to be justified the road improvement should show a saving in the unit cost of hauling as before and after the improvement and this saving should be sufficient, after all costs for maintenance and repair are deducted, to pay a reasonable interest on the original investment."

This rule in other cases is further enlarged by the provision that "in order that the burden upon the local community paying for the road may not be too heavy, road and bridge construction must be justified by the traffic, not only in existence, but which also is productive and road construction projects should only be started when funds are assured for their maintenance."

To the average tax payer and user of the road, however, while cost of haulage is of course of great importance, there are so many other factors entering into the question, such as improved social conditions, general convenience, enhanced land values, etc., that actual saving in haulage costs is not entirely satisfactory basis for justifying a road improvement project and in practice it usually narrows down to a question of the yearly tax the user of the road is prepared to carry in order to secure the boon of good roads.

It is generally recognized that before any considerable advance in road betterment can be achieved there must be an improvement in the methods of management and a definite well-planned system adopted, both as regards the scheme of development and the method of carrying on construction, repair and maintenance. The planning of the system of roads is the first essential step in this direction and the opportunity exists for the engineer of rendering a useful public service, as well as a service to the profession, by advocating the general adoption of this policy by municipalities.

Accompanying this paper were several tables, gathered from various sources, useful to those having to deal with the working out of road development projects.

Discussion on Road Construction.

The discussion on this subject was opened by A. S. Dawson, M.E.I.C., chief engineer, Department of Natural Resources, Canadian Pacific Railway, Calgary. Referring to the first paper, he asked the author if he did not think that more work could be accomplished by the use of a levelling rod rather than a clinometer on road work. In connection with the damage to the corrugated culverts, it is a well known fact that concrete is liable to the same disintegration as the metal culverts, and for that reason some special precaution should be taken in particular instances. Engineering advice and proper supervision are absolutely essential in connection with road construction. In travelling over many thousand miles of country roads in Alberta he was struck by the appalling waste of public money in road construction, hence suggested that we, as an organization, should take steps to secure greater co-operation between municipalities and the provincial governments. He instanced a case of one municipality planning to build one hundred and fifty miles of highways, having purchased road-making machinery costing, approximately, $3,000.00, and where no attempt was being made to secure engineering supervision. In connection with the location of trunk roads, which is an important matter, as they mean much to the development of the rural communities, it is necessary to consider that they be built parallelling the railroads. This has been adopted in the State of California, hundreds of miles of former roads having been abandoned, and the money concentrated on trunk roads. This also applies to what might be termed diagonal roads.

J. N. deStein, M.E.I.C., consulting engineer, Regina, advocated approaching the Governments with suggestions tending to eliminate the conditions outlined by Mr. Dawson. Municipalities should be compelled by law to have engineering supervision in road-making, and day labor should be abolished. Road work should be done by contract in rural municipalities.

D. B. Dowling, President of the Canadian Mining Institute, was given a hearty reception on rising to add to the discussion. He outlined the adverse conditions working against proper road construction on the prairies. It would be better, he thought, instead of plowing up the roads, to leave the original roadway intact, as the present system of breaking the surface and then piling up the earth did not give sufficient foundation.

E. G. W. Montgomery, A.M.E.I.C., Regina, stated that more consideration should be given to a proper sequence in road construction; parts of a road where travel was more difficult should be given first attention and the best portions left to the last.

J. D. Robertson, A.M.E.I.C.:—"For the past six or seven years, at least, in the Province of Alberta, we have always left a centre of sixteen feet of the old sod untouched. That is as far as Government work is concerned. An Act to provide for a system of highways in the Province of Alberta takes care of the point raised by Mr. Dawson regarding co-operation between the municipalities and the Provincial Government."

H. S. Carpenter, A.M.E.I.C., requested information concerning the sixteen feet referred to, as to whether it was covered up with the soil from the ditches or not, and received an answer in the affirmative. Too often a mistake is made in the Province of Saskatchewan of cutting up the grass trail instead of allowing traffic to be continued on this surface.

C. P. Richards, A.M.E.I.C., Regina, stated that legislation designed to regulate the practice of engineering could be designed to do away with all this ridiculous expenditure of public money in connection with road building. In parts of Saskatchewan it is necessary to overlay the roads with straw, and cover this with a sprinkling of gravel, but this, of course, had obvious disadvantages. Reference has been made to a traffic census but in Saskatchewan the only means of securing data in this connection is from the records of the ferries, where an account is kept of all traffic.

M. A. Lyons, M.E.I.C., agreed with what Mr. Dawson suggested that the Institute should co-operate with the Provincial Governments. This would be a field for a committee of this Society. In Manitoba part of the roads are constructed under the Good Roads Act, and the rest are built under supervision. Members of the Institute should be familiar with the road policy of the provincial governments.

George W. Craig, M.E.I.C., city engineer, Calgary, stated that we are still in our infancy in our Western provinces regarding the construction of paved highways. The proportioning of these pavements is to-day an exact science, and it would appear that the road metal, that is, clay and sand, is just as susceptible of analysis. Too much publicity is given to proposals made at Good Roads Conventions and other places by men who do not belong

to the profession and who know nothing whatever about the subject. Both now and probably for all time to come we must consider that a large proportion of our roads will be earth roads, consequently we must deal with that phase of the subject. There was a great deal of talk about permanent highways which should be left out of consideration for the time being. The densely populated portion of such states as Indiana and Michigan, the Northern states and parts of Ontario, can support the construction of permanent highways, which are entirely out of the question in these provinces.

J. D. Robertson, A.M.E.I.C., recalled an incident which happened on a straw made road, where the automobile set fire to the straw, which consumed the car, the Province having to pay for its loss.

William Pearce, M.E.I.C., Calgary, who has had a longer experience with the highways of the Prairie Provinces than any other member of the profession, spoke at some length on this subject. He pointed out emphatically that probably ninety per cent of the roads in the Prairie Provinces must always be earth roads, and therefore we must as engineers make the best possible roads we could with that material. The two important considerations were a proper surface and provision made for suitable drainage. In most cases a surface two feet above the water line was ample, but this necessarily depended on the nature of the soil. Excess of alkali present requires a surface higher than two feet otherwise the likelihood of a bad road. The Provincial Governments could not devote money to better a dvantage than by making experiments to discover the proper proportioning of sand with the gumbo to ascertain what would give the best results; and also find out what depth of material would be required.

W. G. Chace, M.E.I.C., chief engineer, Greater Winnipeg Water District, remarked on the conditions concerning the handling of materials when ditching or excavating. The road question was one concerning which we should not be too impatient. Provision must be made for some specification for road construction, and a scheme devised embodying a definite plan or policy, whereby a proper programme of road building, supervision, and maintenance can be carried out, the latter being even more important. Conventions of this kind serve a useful purpose only inasmuch as progress is made to reach some conclusion, which marks a step in advance. Mr. Chace moved that this meeting appoint a committee consisting of H. S. Carpenter representing Saskatchewan, M. A. Lyons representing Manitoba, and J. D. Robertson, representing Alberta to draw up a standard road specification, including a road policy, and report back to the next Western professional meeting.

In seconding the motion, G. D. Mackie, M.E.I.C., emphasized the point that engineers should take the initiative and lead the way, showing motor clubs and the public generally what was required in the way of roads, and what roads could be constructed with the materials available. In speaking to the motion, E. Brydone-Jack, M.E.I.C., Winnipeg, stated that in the past nearly every other organization except the engineering profession was discussing the question of good roads, and from our intimate contact with this work, we were the ones to show others what should be done. It might be necessary to give direction to legislation.

President Vaughan endorsed the formation of a committee, stating that through traffic roads at least should be built and maintained by the State, and that we would never have the roads up to the standard needed if each municipality built the part within its own limits.

The resolution carried unanimously. William Pearce suggested that this committee's report be published in advance, and W. M. Stewart, consulting engineer, Saskatoon, suggested that greater publicity should be given to any undertaking of this kind on the part of engineers.

Western Road Policy and Methods of Finance.

This section of the meeting was opened by W. H. Greene, A.M.E.I.C., assistant city engineer, Moose Jaw, by reading abstracts from his paper "Methods of financing for Good Roads" which was published in full in the August issue of the Journal.

M. A. Lyons then read the paper by A. McGillivray, A.M.E.I.C., highway commissioner of Manitoba, on "Financing Road Improvement in Manitoba."

Financing Road Improvement in Manitoba.

The question of financing road improvement is one in which the municipal engineer should be much interested and with which he should be somewhat familiar. While the actual cost of building a piece of road or the method of acquiring the funds to perform the same do not enter into its theoretical design or practical construction, still they have a direct bearing on the type and standard that should be adopted for any particular locality.

Generally speaking, roads are established and maintained in a country for the purpose of developing its commercial and industrial life. Doubtless the development of a country's social life is much affected by the roads existing within its borders. In fact the benefits ensuing from good roads taken from the latter viewpoints are almost immeasurable. Nevertheless, the commercial aspect of the question is the one generally viewed by municipal authorities and engineers when planning the construction of a road or system of roads and the problem of determining the standard to be constructed in a given case resolves itself into a question which is largely economic. Therefore, the question should be asked and established: Will the benefit secured from the construction of a certain high standard of road justify the financial expenditure involved before such road is built in that community? Some people have a tendency to adopt the principle that the best, meaning the most expensive, is the cheapest in the end. This is only true to a very limited extent in road construction and where actual traffic conditions demand, or where, in the near future, it may be reasonably presumed that they will demand the highest standard of construction. The type of road that should be built is one that will produce the necessary convenience with the least annual overhead cost for maintenance, in addition to interest on initial expenditure.

Roads being a public utility; the cost of producing them should be shared by all, on as fair and equitable a

basis as can be devised, and to this end the principle of government assistance, especially on main trunk roads and main roads to markets, is justifiable.

In Manitoba, the Provincial Government assumes certain proportions of the cost of building the aforementioned class of roads under "The Good Roads Act, 1914" of the Province. On main trunk roads radiating from the larger centres of population and connecting enroute the towns and villages, the proportion borne by the Province as a whole is 66⅔ per cent of the cost, the balance being paid by the municipality or municipalities through which the road passes, each municipality affected bearing 33⅓ per cent of the cost of the section within its boundaries. The larger portion of the cost of these roads is borne by the Government on the assumption that they are used to a greater extent by non-residents of the municipalities through which they pass than by the local residents, a condition which with the increased use of the automobile as a popular mode of long distance travelling will be largely augmented in the future.

On main markets roads, the Province pays 33⅓ per cent of the cost of constructing earth roads, and 50 per cent of the cost of gravel, macadam or other types of a higher standard than the common earth grade. The extra assistance is given on the superior type of road on account of the heavy cost of obtaining the materials suitable for road surfacing in many of the municipalities of the Province, and also as an incentive to the municipalities to undertake the building of gravel and stone roads on their main lines to market.

The cost of bridge construction on the two systems above mentioned is shared by the Province in the same proportion as on road construction. On bridges which are not situated on a Good Roads system under the meaning of the Act, the Government also contributes to the cost of their construction to the extent of 50 per cent of the cost of permanent structures entailing an expenditure of $200.00 or over, and 33⅓ per cent on structures of a temporary nature, such as timber and costing $500.00 or over.

The funds to provide for Government assistance to municipalities under "The Good Roads Act, 1914" are borrowed as a capital charge on the Province, being raised by the issuance of provincial bonds or debentures. The present Act provides for the issuance of $2,500,000.00, of which up to the present time about $1,250,000.00 has been used.

The Act also gives the municipalities power to issue municipal debentures to defray their share of the cost of works being performed in the improvement of roads, limiting the amount that can be thus raised by a municipality to 6 per cent of the total assessed valuation of all its taxable property, and as shown on the last revised assessment roll of the municipality. The rate of interest that may be paid on such debentures is limited to 6 per cent, and the currency of the debentures must not exceed 30 years. They are retired within the stated time by equal annual payments of principal and interest, thus eliminating the necessity of a sinking fund or of making other provisions for the repayment of principal at the expiration of the debenture period.

The retiring of rural municipal debentures by the serial or fixed annual amount method has much to commend it over other methods, as in many rural districts the establishing of a sinking fund for this purpose imposes an undue responsibility on a rural council, the members of which in many cases are inexperienced in handling this class of business and unless the trust funds were deposited with the banking institutions of the Province at a considerable loss of interest, their reinvestment would be more or less precarious. The policy of the government of the Province in this respect is to relieve the municipal authorities of this responsibility by insisting on the issuance of serial debentures, which with the guarantee of the Government of the Province endorsed thereon makes them a more acceptable investment to the purchaser, and a safer business transaction for the municipality. No indebtedness by which the security of the municipality is mortgaged should be incurred without the consent of the ratepayers affected. The Manitoba Good Roads Act requires the assent of a majority of the ratepayers actually voting to a by-law authorizing the Council to issue the stipulated amount of debentures before such authority is legal and binding.

The financing of road construction by the issuance of long term debentures, say up to 25 to 30 years, is, in the opinion of the writer, a most legitimate method. Certainly the large amount of this work that is so urgently required in this country at the present time could not be done on the "pay as you go" plan. It is not, however, a question of the end justifying the means. Such works as drainage, earth grades, concrete and steel bridges and culverts; essential features in road construction may well be considered permanent works with resultant benefit extending far into the future, and it is unfair indeed to ask the present day ratepayers to pay at once for works of this nature. Again the securing of sufficient funds to undertake the construction of a system of roads permits the work being completed in shorter periods of time under more efficient organization and management, thus ensuring better work, more continuity of plans and immediate enjoyment of the resultant benefits. The cost to the ratepayer in pursuing such a method does not necessarily entail a larger annual outlay than that at present being levied in many municipalities in endeavoring to construct roads in such lengths of sections as their respective yearly appropriations will permit. Many municipal councils in Manitoba are spending annually on road work as much as from $10,000.00 to $15,000.00 without getting very far in a connected system of highways. Now from the capitalization of such an amount, or even a portion thereof, a very considerable fund could be secured with which to complete a substantial system of roads. For instance, for several years previous to 1912, the municipality of Wallace in Manitoba was spending $15,000.00 annually in endeavoring to improve road conditions there with very poor results, the bulk of the money being spent in grading sloughs without any attention to drainage or other permanent work. In 1912 the Council decided to take advantage of "The Good Roads Act" then in existence and with the assistance of the department engineers laid out a plan of work comprising the building of 198 miles of roads. Debentures to the amount of $198,000.00 have been issued by the municipality, which

amount with the assistance of the Province of a like amount will carry the scheme to a satisfactory completion, giving the municipality 198 miles of well built gravel roads properly drained and bridged throughout with permanent concrete structures. The annual levy on the ratepayers of the municipality to meet the indebtedness thus incurred is $12,205.53, or about $3,000.00 less than when the scheme was undertaken, which latter amount will more than maintain the mileage constructed for a number of years until the renewal of gravel surface is needed. Provision for proper maintenance is a most essential feature in highway improvement work, especially should provision be made therefor where construction has been affected by Debenture proceeds. The Manitoba Act places the responsibility and expense of maintaining roads built under Government assistance on the municipality, but reserves the right to the Government of performing such work as may be necessary in this connection and levying on the municipality for the money so expended should the Council neglect or fail to maintain the same.

In the absence of L. C. Charlesworth, M.E.I.C., deputy minister of Public Works, his paper on the provincial policy of Alberta in financing roads was read by J. D. Robertson, A.M.E.I.C.

Provincial Policy of Alberta in Financing Roads.

I have been asked to say something with regard to "The Provincial Policy of Alberta as to the Financing of Roads". I am not just sure what phase of the question it is desired that I should discuss, but there are several different angles from which the subject may be approached, any one of which opens up a wide field. At first thought, "The Provincial policy of Alberta as to the Financing of Roads", appears to mean the question of raising the money which is spent on roads by the Province. This leads us to the question of what roads the Province is to assume responsibility for, and the extent of that responsibility.

There is also the question of how good, i.e., how *expensive* a road is justified in each particular case.

In practice generally, the commonest financing question to be solved, is, how to build a road costing two or three thousand dollars, which is absolutely needed, with one thousand dollars which is all there is available for the purpose.

So far as Alberta is concerned, the passing at the last Session of the Legislature of an Act entitled "The Public Highways Act" has settled for the time being some of these questions. This Act provides for the division of all the highways in the Province into three classes: Main Highways, District Highways, Local Highways, and the responsibility for the cost of construction and maintenance of an highway of any class is specifically set out in the Act, as is also the proportion of the cost to be borne by the Province and by the local authority of the municipality within which the highway lies.

Main highways are defined as "Such highways as the Minister of Public Works deems to be of prime importance, either by reason of being trunk channels of communication between the more important cities and towns of the Province, or with the main travelled roads situate outside and adjoining the Province, or for other good reasons". The location of these main highways is established only after consultation with the municipal authorities in the municipal districts within which they lie, and the route is then laid down exactly upon a map. This map forms the basis of an Order-in-Council establishing the road as a "Main Highway" under the Act.

The cost of construction of these main highways is to be borne jointly by the Department of Public Works and the local authorities in the proportion of seventy-five and twenty-five per cent respectively, and the cost of maintenance is to be borne entirely by the Department.

"District Highways" are those which the Minister considers to be of less importance generally than Main Highways, but still of considerable local importance. Their location is to be established by Order-in-Council in the same manner as Main Highways, but only after agreement with the municipal authorities of the districts through which they are intended to run. The cost of construction is to be borne by the Department and the local authorities jointly in the proportion of twenty-five and seventy-five per cent respectively, and the cost of maintenance is to be borne entirely by the local authorities. In the case of District Highways the Minister may direct that districts through which the highway does not in fact pass, shall contribute towards both the original cost of construction and the cost of maintenance. This provision is made because the case may frequently occur where the people most in need of a particular road to a market town reside in another municipal district.

"Local Highways" are all such highways in the Province as are not classified as Main or District Highways, and they are to be constructed and maintained entirely at the expense of the local authorities within whose district they are situated.

The control of construction shall, in the case of main highways, be under the Department of Public Works, and in the case of district highways, either under the Department or the local authorities as agreed upon, and in default of agreement, under the Department, and in the case of local highways, under the local authorities.

Provision is made in the Act for recovery by the Department from the local authorities of their proper proportion of the cost of highways constructed.

Provision is also made, that where the local authorities fail to properly maintain a district highway after sufficient notice, the department may step in and properly repair or maintain the same, and recover the cost of so doing from the local authorities.

A highway under the Act by definition includes any bridges thereon, but a special clause in the Act provides that the department may repair any bridge on any highway in case of flood or accident, and where the Legislature votes the money for the purpose may build or rebuild any bridge. This provision was made doubtless because it was felt that in many cases bridges of the larger sizes were often beyond the financial ability of the local authorities, and that they had not sufficient experience or equipment to deal with such matters as efficiently as the Department.

The Minister is given power to make rules for the control of all traffic and vehicles on any highway. These rules will probably include some regulations as to the permissible load upon tires of different widths.

The Act does not come into force in its totality until the first day of January, 1919, and in the meantime preparation is being made for the classification of the highways of the Province.

As we have not yet operated under the Act, we are not in a position to give any idea as to where its weaknesses lie. Doubtless it has faults, which can only be made apparent by its application, but we believe it to be a step in advance towards a system of roads in the Province.

These remarks seem to have developed into an explanation of The Public Highways Act of Alberta more than a discussion of the financing of roads, but I trust they may be of some interest.

So far we have only earth roads, and there is no question but that for a long time to come the great majority of our roads must be of that nature, but with the motor car coming into use by nearly every farmer in the country, the value of the smooth road is being realized more widely, and the time is probably not far distant when the people will ask — and will be willing to pay, which is the big thing — for more permanent forms of construction, at least on main highways. Permanent highways cost considerable money, however, and the community must first be educated up to a willingness to bear this increased cost.

If one goes into figures it seems that it should be easy to convince the most pessimistic, for when one considers the saving in cost of hauling farm products, the saving in the cost of operation of motor cars, the saving on depreciation in value of vehicles of all kinds, and the lengthening of the effective life of horses, and the increase in the value of lands, there is without question splendid return for the investment in good roads, without taking into consideration their moral, civic and educational value.

Financing Road Work in Saskatchewan.

H. S. Carpenter, A.M.E.I.C., deputy minister of Highways, Saskatchewan, read his paper already published in the Journal on the Provincial Policy of Saskatchewan, and the Methods of Financing Road Work in that Province. In reply to questions, Mr. Carpenter explained that the province was co-operating with the municipalities this year to the amount of $130,000.00, and outlined the personnel of the Department of Highways for the province, explaining that engineers occupied responsible positions therein. The money expended by the Government in co-operation with the municipalities was spent under the supervision of the Department, but that the Department possessed no authority over the funds contributed by the municipalities, except that the Department gave advice when requested. President Vaughan emphasized the point previously made that if we are to have good through roads, the State must finance them and maintain them, since the local municipalities do not get a proportionate benefit to the tax paid under the present policy. It would be difficult to impose a gasoline tax in this country because of the large consumption by the farmers for other purposes than automobiles. To-day we find properly constructed and properly maintained highways only where they were built and kept under control of the State. L. A. Thornton, A.M.E.I.C., city commissioner, Regina, believed that more and more would the methods of financing roads suggested in the papers be carried out. In the United States it was found that good roads were impossible, unless under engineering control and supervision. Municipalities should not be allowed to raise money for road building, except in conformity with a provincial road policy planned and designed for the future. He was particularly interested in the methods of financing, and explained what had been done in this connection in Saskatchewan during recent years. F. E. Betts, of the Saskatchewan Motor League, gave an interesting talk from the viewpoint of the motorist, and in concluding paid a tribute to the work engineers were doing, and expressed the belief that a policy for properly constructed roads should be devised by the engineers, as they were the men under whose supervision they should be constructed, concluding by saying that the motor leagues had given more advertizing to the engineering profession than they had given to themselves.

Taking advantage of the ideal arrangements made for the visiting members to take up their quarters and get their meals at the University, the meeting adjourned to the University dining-room for supper.

Second Session
8 p.m., Thursday, August 8th.

WATER SUPPLY AND SANITATION.

E. L. Miles, M.E.I.C., inspecting engineer, Department of Irrigation, opened the evening session by reading a paper already published on Rural Community Water Supplies.

The question of rural community water supplies has been and still remains a much discussed subject, and still remains unsolved, owing chiefly to the financial condition of the founders of this young country. However, the provincial governments have done much to assist the rural communities by constructing various types of reservoirs for the collection of surface water, and these schemes should be improved so that the rural districts shall receive the greatest benefit. Deep well drilling has not yet been thoroughly tested, nor has any scheme for the diversion of river water been sucessfully found from a financial standpoint. Water administration, however, is conscientiously carried on by the Irrigation Department through a Dominion Law, and from the records being gathered and compiled, a comprehensive view of the water supply of the provinces of Alberta and Saskatchewan can be had.

George D. Mackie, M.E.I.C., city commissioner, Moose Jaw, read his paper on a "General Water Supply

for Saskatchewan." Inasmuch as Mr. Mackie had only a few days' notice for the preparation of this paper, its excellence does him all the greater credit.

General Water Supply for Saskatchewan.

If there is one fact more than another which has been brought to light by the paper which has just been presented by Mr. Miles, it is this—That the water supply problem of the Province of Saskatchewan, more particularly that section of the province lying to the south of the South Saskatchewan River, and bounded roughly on the west by Thunder Creek and the Canadian Northern line from Moose Jaw to Forward, on the south by the Shaunavon-Weyburn line, and on the east by the Regina-Weyburn line and the Qu'Appelle River and Buffalo Lake with an area of approximately 5,000 square miles, is a serious one, is still unsolved and touches vitally the interests of every inhabitant in that district.

In this large area of country, which from an agricultural point of view possesses land which yields the most productive wheat crops in the world, there are no rivers of any size, and the lakes which dot the country here and there over its area are mostly of an alkaline nature and entirely unsuited for drinking purposes. The geological formation of the country is such that the supply of water from wells, even those which have been drilled to a great depth, is very poor, and none of the large centres of population, notwithstanding the fact that they have spent huge sums of money in endeavoring to acquire abundant supplies of water for their citizens, have been able so far to secure such supplies. The whole population is thus seriously handicapped by the one vital element which goes hand in hand with the progress and prosperity of any country, viz, an abundant supply of pure water.

At the present time the whole of our Dominion has its attention concentrated, and rightly so, on the one aim and object which is material to its further progress, and that is the waging to a successful conclusion the great war which is now in progress, for the peace and safety of civilization; but at the same time the Govenrments of our country are wisely looking ahead to the period of reconstruction which must necessarily follow in all countries on the conclusion of the war, and to the settlement in civil occupations of the large number of soldiers who will return here on the victorious completion of the war, and the works which are to be carried out in this reconstruction period are of vital importance to the engineering profession, as upon them will devolve to a very great extent the designing and execution of any large enterprises on which our Governments may embark.

In our western country the source of all our wealth springs from the cultivation of the enormous tracts of fertile land which have yet only been developed to a small degree, and in order that this section of land of which I speak, to the south of the Saskatchewan River, may be properly developed, and furnish subsistence for the large population which must ultimately dwell on it, as well as supplying its surplus to the needs of the Empire, an abundant supply of water is the first essential to that development.

The question of providing an adequate water supply for the plains of Regina and Moose Jaw is no new one, and has been taken up from time to time by that very enterprising body of engineers who constitute the backbone of our Department of Interior, and as far back as 1894, Mr. Dennis, M.E.I.C., the then Chief Inspector of Irrigation, in his annual report, dwelt on the necessity for some scheme to provide an abundant water supply for these areas. In his report of 1895 he speaks of the necessity of diverting the water of the South Saskatchewan River to these plains for the purposes of irrigating what he terms as " The arid regions of Regina and Moose Jaw ", as well as for the purpose of furnishing an adequate supply of drinking water to the settlers who were then coming in in large numbers to settle on this territory. Since this report was penned, it has been demonstrated that this land can be, and is sucessfully farmed without the necessity for irrigation, but the problem of diverting the waters of the South Saskatchewan River for the purposes of supplying water for stock and drinking purposes still remains.

The question was brought up by another engineer, T. Aird Murray, M.E.I.C., who, in 1911, made a report to the Commissioner of Public Health of the Province, in which he pointed out the inadequacy of the water supplies for domestic purposes in the territory between Regina, Moose Jaw and Weyburn, as well as the Qu'Appelle Valley, and suggested that a supply of water be obtained for this country by diverting the waters of the South Saskatchewan River at Elbow by means of a dam across the Saskatchewan River, a tunnel through the height of land, allowing the water to flow by gravity down the Qu'Appelle to Buffalo Lake, from whence the water could be pumped to the various towns and cities as required.

Walter J. Francis, M.E.I.C., of Montreal, in a report in 1911 on the water supply problem of the City of Moose Jaw, also made reference to this project, and stated:

" When the south half of the Province of Saskatchewan will have become densely settled it is our opinion that the South Saskatchewan River will be found the only source of supply for domestic purposes. We cannot find any evidences at present of any other water supply suitable for cities of fifty thousand population and a densely settled surrounding district. We believe the Saskatchewan to be the proper source, primarily because its supply is obtained from glacial districts and therefore not dependent upon precipitation in the prairie country. It is moreover the only continuously flowing supply of any magnitude in the country. The most feasible route is doubtless that following the valley of Thunder Creek to its source and then crossing over the divide about five miles to the Saskatchewan. From the engineering point of view there are no serious obstacles. The location of the dam on the river, the details of the pumping station, the arrangement and size of the pipe line, and all such features can only be determined by careful study after surveys of the locality will have been made.

The only real obstacle to this project is its cost which will probably run into five million dollars or more."

The Saskatchewan Government at this time appointed a Commission to enquire into the whole question of the

water supply of this district, and their first action was to apply for and obtain a license from the Department of the Interior for diverting 200 sec. feet from the South Saskatchewan River for water supply purposes for the southern part of the province. The Department of the Interior, however, are the real pioneers in this matter, and carried out extensive surveys with the object of locating the best line for a gravity supply from the height of land at the Saskatchewan river to supply the territory already described, and very full reports of these surveys, together with plans, will be found in the Irrigation reports for the years 1912-13 and 14.

It is impossible for me in the short space of time at my disposal to present the problem to you in any detail, but the matter is of such importance to this section of the country that in my opinion the engineering profession would be derelict in its duty did it not take up this matter and point the way to a complete solution of the problem.

In a report recently issued by the Department of the Interior at Calgary, a statement was given of the quantity of water used in various urban communities in the Provinces of Alberta and Saskatchewan, and I find that in twenty of these places the average quantity of water used per day in 1917 amounts to 74.5 gallons per head. Eleven places in Saskatchewan are recorded, and the average quantity of water used in these communities with populations ranging from 350 to 35,000, amounts to 47.9 gallons per head per day. These are figures which, to my mind, demonstrate clearly the inadequacy of our community supplies in the Province of Saskatchewan, more especially when considered alongside the figures for the whole of Canada, which average 111 gallons per head per day.

The population of the district to be served, by a rough computation which I have made, based on the 1916 census, figures out at approximately 50,000, to which should be added another 25,000 for the purely rural areas, making a total population to be supplied of 75,000, and if this population is doubled to allow for future growth, the problem is to supply a population of 150,000 scattered over 5,000 square miles with 15,000,000 gallons of water per day.

From the Hydrometric Records of the Department of the Interior, the minimum flow of the Saskatchewan River at Saskatoon is given at 1247 sec. feet in the period from 1911 to 1917, and this occurred in January 1913. The maximum flow recorded in the same period is 60,566 sec. feet in July 1916. If we take the figure of 20,000,000 gallons, or 37 sec. feet, per day, which in my opinion would serve this community for the next twenty years, it is found that this amount equals slightly less than three per cent of the minimum flow of the river, so that there can be no question or doubt as to the adequacy of the South Saskatchewan River to supply now and at all times in the future the needs of the Province in regard to water supply.

Two schemes have been surveyed by the Irrigation Department, one to secure a supply of water from the river at Elbow, which necessitates the carrying of the water over the height of land, which at this point is 88 feet; the construction of a small reservoir on the height of land, and the flow by gravity from the reservoir along the qu'Appelle River to Buffalo Lake, where it is proposed to construct a dam and impound the waters. From this dam it would be necessary to pump the water over a height of land approximately 300 feet high before it could be delivered to either Regina or Moose Jaw.

The objections to this scheme, in my opinion, are many, the first and most important being that the river bed of the qu'Appelle River north of Buffalo Lake is of black swampy earth, and of such a character that any water turned into it, for domestic purposes, would be badly poluted; and again, the area draining into Buffalo Lake yields a flow of approximately 30,000,000 gallons per day, and the loss by evaporation and other causes amounts to practically the same figure, so that until the consumption of water under this scheme reached the figure of 30,000,000 gallons per day, the communities would be supplied, not with South Saskatchewan River water, but really with a mixture of Buffalo Lake and South Saskatchewan River water, in which the waters of Buffalo Lake would predominate.

The other scheme presented, and for which many surveys have been carried out by the Department, necessitates the pumping of water from the Saskatchewan River near Shellstone Creek, over the height of land, which is over 300 feet, with a gravity pipe line following to some extent the valley of Thunder Creek. The objection to this scheme is the height of land which it is necessary to overcome, and to the fact that the gravity pipe line would touch none of the larger centres of population which it is necessary to supply.

The estimates for these schemes run all the way from five to twenty million dollars, figuring on a supply varying from 30,000,000 to 100,000,000 gallons per day. When these schemes were propounded, of course, they did not appear visionary, but since 1912 we have all got down to earth, and it is now felt that a scheme of very much less magnitude will be sufficient for the district for many years to come, and, in my opinion, any scheme which provides for a maximum of 15,000,000 gallons per day will be absolutely adequate for the next fifteen to twenty years.

Granted that it is proven that this district will require a supply of water from the South Saskatchewan River in the very near future, there are a number of essential points which any such proposed scheme must embrace:—

(1) The scheme must be reasonable in cost.

(2) The pipe line must follow a route from the river which would easily be accessible to the larger centres of population to be supplied.

(3) The water should be delivered at sufficient pressure to supply the urban centres without the necessity of further pumping.

(4) The manufacture of material necessary for the works should be carried out as far as possible on the route of the proposed works.

H. E. M. Kensit, M.E.I.C., prepared a report to the Department of the Interior in 1913 on the question of the sources of power available for pumping water from the South Saskatchewan River, and at the conclusion of his report he says that all the proposals have been based

on a gravity supply delivering the water with little or no pressure at the level of the C. P. R. rails in each city, and points out that the basic idea of an undertaking of this kind should be to make the supply readily available not only for the larger cities, but for a large number of the intermediate smaller towns, and that by a gravity supply this idea is not carried out. On the other hand he points out that with a pressure system, a much smaller diameter pipe could be laid, and the pipes could be made to follow the route of a railroad, and near the centres of population.

In this opinion I entirely concur, and in any scheme which is adopted the water supply main should certainly parallel as nearly as possible some one of the lines of railways running from the river to the centre of the district between Regina and Moose Jaw.

I have endeavored to outline the problem which faces the community to the South of the Saskatchewan River, and I think t hat this meeting of engineers should not separate without taking some action by way of focusing the many schemes which have been proposed for a solution of the problem, and they should further impress the Dominion and Provincial Governments with the fact that the assistance of the engineering profession is at the disposal of these Governments, so that a perfect scheme may be placed before them and carried out immediately after the completion of the great war.

W. M. Scott, M.E.I.C., consulting engineer, Winnipeg, noted with considerable satisfaction that more and more were engineers willing to give each other the benefit of their experiences, and consequently a meeting such as this, where valuable ideas were presented, meant much to those fortunate enough to attend. The question of water supply was an engineering problem, and while there was a Waterworks Association in the United States, he felt that such was not necessary in Canada, because so many of our own Institute were interested in that problem. He outlined the conditions in Manitoba. Farmers should be educated and impressed with the fact that they should have a proper water supply and be prepared to pay the price. He believed there should be a provincial water survey which kept a record of wells and also an account of their performance, and that this should be made compulsory. A. S. Dawson, M.E.I.C., Calgary, pointed out that in Southern Alberta there were districts where it was impossible to secure a run of water, and to overcome this the settlers found it necessary to collect water in outdoor cisterns during the fall and winter months, their capacity being from 75,000 to 100,000 gallons. J. E. Underwood, A.M.E.I.C., consulting engineer, Saskatoon, gave an interesting description of overcoming the difficulty in securing a water supply through seventy-five feet of quicksand. A twelve inch casing was sunk in the quicksand, and inside this an eight inch one provided with shadow screens inserted. The space between the casings was filled with coke, and after considerable difficulty the twelve inch casing removed. After three years' operation, this method has been proven perfectly satisfactory. He also described a tank provided with a filter basin for a rural supply system which thoroughly served its purpose. D. B. Dowling, who is an expert on the geology of Canada, using for illustration a relief map covering the middle prairies, explained thoroughly the relation of the water supply to the geological formation. In deep well drilling salt water was encountered because the underlying sandstone had been the bed of a salt sea, and the rock had remained saturated since that time. The inclination of the rock strata explained why it was possible to secure an ample supply of water in some parts, and very little in others. He mentioned instances of wells having been drilled and water secured from water bearing boulder clay, and on drilling the well to a greater depth this water was lost. In the boulder clay the great majority of wells are found to be successful. The water is almost certain to be alkaline if the well is continued into the shale underlying the clay. He suggested that some engineer might make a study of the magnetic water finder to discover why it worked in some instances and not in others. A comprehensive water supply system could only be undertaken when the country was richer, and more thickly populated.

R. F. Uniacke, M.E.I.C., superintendent, Dominion Penitentiaries, Ottawa, speaking on the subject of rural sanitation and water supply, described a system he had installed in the penitentiary at Prince Albert, which contained features which were worthy of special note. Since this had been installed, although considerable difficulty had been experienced in dealing with quicksands, and which they had overcome by inserting short lengths of pipe drawn to a point which rested in the quicksand and led to the well casing, an adequate supply of water had been secured, and the results had been satisfactory. W. G. Chace, M.E.I.C., had also experienced difficulty with quicksands. He described it as a body of sand, flowing under water pressure, consisting of particles of uniform size. He found that placing about 6″ of coarse sand on quicksand resulted in giving a compact material, and in this manner the problem of securing a suitable foundation has been overcome. The City of Winnipeg is spending sixteen million dollars to provide a necessary water supply, designed to provide for one million people, with an average daily consumption of 85 gallons per capita. It would not be wise for a body of engineers to endorse a scheme of water supply for Saskatchewan which did not amply provide for the future. The scheme suggested by Mr. Mackie is one that should be taken up by the Dominion Government. An adequate water supply would be a great factor in enabling the country to support a larger population. F. H. Peters, M.E.I.C., chief engineer, Irrigation Department, Calgary, was glad to see such a lengthy discussion on this subject of water supply, because the men in the East did not realize the real problem the water situation, particularly in the southern portion of Saskatchewan and Alberta involved, where the natural water supply was in places insufficient to develop agriculture or industry, and in some cases for human habitation. With the present water supply it is impossible to maintain large centres of population. The seriousness of our water problem here as regards future development has probably not been sufficiently emphasized in the East, and is one which the Dominion Government should take up through the Department of

Public Works. Gerald Graham, Secretary, Board of Trade, Saskatoon, was in hearty sympathy with the discussion of the important problem of water supply by engineers, and felt that good would result therefrom. Professor A. R. Greig, A.M.E.I.C., referred to the fact that legislation had been drafted for Saskatchewan, providing for the licensing of well drillers, which would enable the Government to secure the necessary data on wells required. H. S. Carpenter, A.M.E.I.C., asked for information regarding magnetic water finders. In response to his query, George W. Craig, Calgary, said that this matter had been made the subject of investigation by the United States Government, concerning which a bulletin had been issued. The substance of this bulletin was to the effect that finding water by divining was not satisfactory, and that no device had yet been invented which enabled people to locate water satisfactorily by this means. C. J. Yorath, A.M.E.I.C., city commissioner, Saskatoon, in referring to the water problem of Saskatchewan, stated that it did not concern the Northern portions particularly, but more vitally affected the middle and Southern parts. The North, however, would be interested in any action taken to provide an adequate water supply for the South. The question of hydro-electric development, which was at present lacking in the province, might well be considered when the water problem was taken up. A. S. Dawson gave further information regarding water finders, informing the meeting that the bulletin referred to by Mr. Craig was issued by the U. S. Department of Agriculture as the finding of a Committee which investigated the subject, and reported adversely on water finding devices. E. G. W. Montgomery, A.M.E.I.C., stated that his experience with water finding devices had been satisfactory. L. A. Thornton, M.E.I.C., Regina, discussed the problem from the viewpoint of the City of Regina, where at present the water consumption is one hundred gallons per capita, and where it would be necessary to educate the public to reduce this to a more reasonable amount. The supply from the Saskatchewan River would ultimately have to be used, but in the meantime it would be necessary to make the most of every possible source of supply. Later it would be necessary to use the Saskatchewan, and he thought that it would require much study. It devolved upon municipalities, the Government and the railways, to provide a fund to appoint a board of a first class engineers to make a report on the general water supply problem for Saskatchewan. Wm. Pearce, M.E.I.C., believed, as a result of many years' experience, that not ten per cent of the rainfall was conserved, and expressed the belief that this was a source which should be given more consideration. Provision for cisterns was not receiving sufficient attention. He had provided an ample supply of soft water in his own home by this means, and thought that generally speaking the advantage of thus conserving water was overlooked.

The paper on "Rural Sanitation" by W. Muir Edwards, M.E.I.C., professor of Civil Engineering, University of Alberta, on the programme to be read at this meeting was not presented owing to the fact that the author had been called to the United States on other important business.

President Vaughan asked if there was any further discussion, and none being forthcoming, the meeting adjourned at ten-fifteen.

Third Session
9.30 a.m. Friday, August 9th.

CONCRETE.

At the opening of the third session, L. B. Elliott, Member of Council, occupied the chair.

The interest which the publication in advance of two of the papers dealing with the deterioration of concrete had aroused showed that this would be an intensely interesting session, and such proved to be the case.

B. Stuart McKenzie, A.M.E.I.C., consulting engineer, Winnipeg, read the first paper on the programme as it appeared in the August issue of the Journal on "The Deterioration of Concrete" which he illustrated by a number of slides showing masses of disintegrated concrete, and illustrating various examples of concrete foundations and concrete beams, in parts of which the concrete had disappeared entirely. The author pointed out that in practically every instance that had come under his observation where concrete had disintegrated it was exposed to water. He did not attempt to theorize, as it was expected that succeeding papers would go into the subject fully.

H. M. Thompson, of the city chemist's department, Winnipeg, read the paper by A. G. Blackie, city chemist, Winnipeg, on "Causes of Disintegration of Concrete".

Causes of the Disintegration of Concrete.

The disintegration of concrete is due to the presence of the so called alkali salts in the soil and to the presence of ground water which dissolves these salts and carries them into the concrete. The so-called alkali salts that occur in the soil in this District are sulphate of sodium, magnesium and calcium, these salts are also found in the ground waters. The salts are found in deposits and, I think, are generally found only near the surface.

Chemical analyses of disintegrated concrete show that the disintegrated portion contains a much higher percentage of sulphate than the original materials used in the concrete, and also that the disintegrated mass is impregnated with minute crystals of calcium sulphate, these crystals are found in great quantities in the disintegrated material and gradually become fewer as the portion of the concrete unacted upon is approached.

The solubilities of the above sulphates in cold water are in the following proportions:—

$Mg\ So_4$ 30 parts in 100 parts cold water

$Na_2\ So_4$ 4.3 parts in 100 parts of cold water

$Ca\ So_4$ 0.18 parts in 100 parts cold water.

As might be expected from their solubilities the deposits usually contain more calcium sulphate than Mg or Na sulphates.

With regard to the solubilities another point that has to be remembered is that whilst the solubility of $Ca\ So_4$ is low in distilled water, the solubility is about doubled in a solution of salt or Na C1 and also that all our ground waters in this district contain more or less salt, in some instances being so brackish as to be unpalatable. Research into the chemical action of alkali in cement has been carried out for some years by different experiment stations in the United States, and all are agreed that the sulphates are the principal causes of the trouble. Just how they react with the concrete is disputed.

Bulletin 81 of the Montana Experiment Station published in February 1911 advances the theory that disintegration is due to the formation of compounds which have a greater molecular volume than that of the compounds in cement which are acted upon by the solutions, these cause expansion and subsequent cracking.

Another theory put forward is the formation of tricalcium sulpho-aluminate, this compound causing cracking and subsequent disintegration. Technologic Paper No. 95 issued by the Bureau of Standards in 1917 proves that this compound cannot be formed, but the authors of this bulletin do not commit themselves to any definite theory and summarize their work as far as it has gone with the following conclusion:

> "No definite conclusion can yet be drawn as to the ultimate resistance of concrete to the action of alkali in the soils and waters of the projects. However, the complete failures found at the Belle Fourche project where local materials were used, together with the action which has commenced on the surfaces of many of the blocks on other projects, indicates that materials of good quality and proper workmanship are of greatest importance.
>
> Concrete which is to be placed in alkali soils should be made of selected and tested materials, so proportioned as to produce a dense concrete. As small an amount of mixing water should be used as will allow the mass to be properly placed. Unless these precautions are taken the resistance of the concrete to alkali will be reduced.

On page 93 of Technologic Paper No. 95 Bureau of Standards, the following conclusions are drawn regarding the use of cement draintile exposed to soils and water containing alkali salts in quantities of 0.1 per cent or more.

1. The use of cement tile in soils containing alkali salts in large quantities is experimental.
2. Porous tile due to the use of lean mixtures or relatively dry consistance are subject to disintegration.
3. Some dense tile are under certain conditions subject to surface disintegration.
4. Disintegration is manifest by physical disruption caused by the expansion resulting from the crystallization of salts in the pores and by softening, resulting from chemical action of the solutions with the constituents of cement.
5. While results obtained will not permit of a definite statement as to the relative effect of the various constituents of the salts indications are that the greater the quantity of sulphate and magnesium present and the greater the total concentration of salts the greater will be the disintegrating effect.
6. Tile made by the process commonly used, which allows the removal of forms immediately after casting, are subject to disintegration where exposed to soils or waters containing one-tenth per cent or more alkali salts similar in composition to those encountered in this investigation.
7. The hand-tamped tile of plastic consistency as made in this investigation are not equal in quality to machine-made tile of the same mixture, and they do not resist alkali action as well.
8. Steam-cured tile show no greater resistance to alkali action than tile which are cured by systematic sprinkling with water.
9. Tile made of sand cement have less resistance to alkali action than tile made of Portland Cement of the same proportions.
10. The tar coating as used is not effective in preventing the absorption of alkali salts from the soil.
11. The cement-grout coating is not effective in preventing the absoption of alkali salts from the soil.
12. No advantage is found in introducing ferrous sulphate into the cement mixture.

> If cement draintile are to be used in alkali soils or waters containing 0.1 per cent or more of salts similar in composition to those encountered in this investigation, they should be made of good quality aggregate in proportions of not less than 1 part Portland Cement to 3 parts aggregate. The consistency should preferably be quaking, which has proved the most resistant of all mixtures used. (See description of tile series 2.) This is wetter than that generally used in commercial tile plants and will probably require the retention of the tile in the molds for several hours, unless some means are found to hasten the hardening of the cement.

In contrast to this we have here for exhibition a piece of draintile taken from the ground beside the Grain Exchange footings where it has been exposed to the ground waters for 30 years. The concrete is perfectly sound and shows no sign of disintegration. Unfortunately details of the mixture used in the manufacture of this pipe are not available.

The University of Wyoming Agricultural Experiment Station, Bulletin No. 113 published in March 1917 summarizes the results of their work with the following conclusions:

1. Cement put into solutions of alkali sets as well as in water.
2. In solutions of sodium sulphate $Ca\ So_4\ 2\ H_20$ is formed.
3. In solution of magnesium sulphate $Ca\ S0_3\ 2\ H_20$ and $Mg\ (CH)_2$ are formed.

4. In solution of sodium chloride a silicate is formed. The high percentage of sodium in this silicate is likely the reason for the increase of insoluble sodium in the cement.
5. Sodium chloride in solution or its presence in solution with other alkali salts has its effect chiefly through a solvent action.
6. Of the solutions tested the five per cent sodium sulphate had the greatest disintegrating effect.
7. Solutions containing (mixed) chloride, sulphate, and carbonates had the least effect.
8. Mortars disintegrate faster than neat cement.
9. The formation of compounds of greater molecular volume than the volume of calcium hydroxide is not the cause of the disintegration of cement.
10. The ultimate cause of the disintegration of cement is due to the alkalis forming compounds with the elements of cement, which are subsequently removed from the cement by solution.

The conclusions drawn in all these summaries are more or less supported by experimental work and yet they are to some extent contradictory, this shows the necessity for further work and research on the question. However, the final paragraph of Bulletin 113 from the University of Wyoming summarizes the whole situation that is that ground water must be taken care of. The writer's first experience of the disintegration of concrete occurred when some years ago in Winnipeg it was reported that one of the large concrete sewers of the City was being destroyed by sewage. With the city engineer a careful investigation was made of the sewer, and it was found that all of the disintegration occurred high up in the sewer, and that there was no evidence of disintegration at or near the water level. The disintegrated concrete was soft and of putty like consistency.

An analysis of a sample of disintegrated concrete from this sewer showed the sulphate content to be 2.54 per cent. The concrete from which the sewer was made consisted of limestone, sand and cement although we have no analyses of these materials it may be assumed that with the exception of the cement the concrete materials would not contain any sulphate. If we assume that the cement used contained 2 per cent SO_3 (The standard specifications requires that Portland Cement shall not contain more than 1.75 per cent SO_3) and that the concrete was mixed in proportions 1 part cement to 7 parts of aggregate then the SO_3 in the concrete would be 0.25 per cent yet the analysis shows SO_3 content 2.54 per cent.

Samples of concrete from four other sewers where disintegrated concrete was found showed SO_3 content 5.02 per cent, 5.03 per cent, 2.35 per cent and 5.90 per cent. These percentages are all very much higher than could be reasonably expected and confirm the results of laboratory experiments which show that solutions containing magnesium and sodium sulphate react with the cement and also the limestone.

From various minor laboratory experiments carried out by the writer at different times a conclusion was reached that some interesting information might be obtained and some light thrown upon the disintegration of the concrete by determining the action of the various alkali solutions upon the sands used locally in the composition of concrete. Accordingly some tests were made using a sand known locally as Birds Hill sand and having the following composition:

Silica (SO_2)	47.54%
Iron & Alumina (Fe_2O_3 & Al_2O_3)	28.32
Loss on ignition	19.32
Calcium (Ca)	3.71
Magnesium (Mg)	0.57
	99.46%

It was found that .009 per cent was soluble in water and of this .0012 per cent existed as water soluble sulphates stated as SO_3. The sand was then extracted with the following solutions.

1. 10 per cent magnesium sulphate.
2. 5 per cent calcium sulphate plus 10 per cent socium chloride.

These experiments showed that to some extent these alkali solutions had a solvent effect upon the lime in the sand. These tests were not brought to a definite conclusion and further investigation is necessary along this line.

Some further tests were then made on briquettes made with cement and limestone in proportions of 1 to 3 by weight. The limestone was graded so that its grains would be the same size as those of Standard Ottawa sand. These briquettes were placed in the following solutions:

5 per cent magnesium sulphate
10 per cent sodium sulphate
5 per cent calcium sulphate plus 5 per cent sodium chloride

and also in a solution made from white soil deposit having the composition:

Calcium sulphate	62.5
Magnesium sulphate	37.5

These briquettes showed rapid deterioration by softening of the edges, reduction in tensile strength and also by the solution becoming turbid.

In previous experiments some indication had been given that mortar coming into contact with the alkali ground water before it had thoroughly hardened would disintegrate rapidly. With this in mind a series of tests were made in conjunction with the officials of the Greater Winnipeg Water District.

Four sands were selected for these tests differing both in grading and chemical composition. A large number of briquettes were made from these sands for 1 to 2 and 1 to 3 mortars. A set of neat cement briquettes were also made for comparison.

For each mortar 40 briquettes were made and cured 24 hours in a moist closet, 20 of these were then placed in the following solutions:

(1) Distilled water; (2) Tap water; (3) 10 per cent magnesium sulphate; (4) 10 per cent sodium sulphate.

The remaining 20 briquettes were steamed by being placed on a rack over water in a copper boiler such as is used for testing cement pats. The temperature was

maintained as nearly as possible at 150°F. After 48 hrs. steaming the briquettes were placed in solutions corresponding to those used for the unsteamed sets. From the five briquettes in each of the sulphate solutions two were removed and kept in air for 24 hrs. and then replaced in solution 24 hrs. This treatment was continued throughout the test which was for a period of 3½ months. Some of the briquettes disintegrated and some remained firm. In general 1 to 2 mortars withstood the action of the sulphates better than the 1 to 3 mortars and the unsteamed briquettes better than the steamed. Some of the latter were so badly swollen and disintegrated that it was thought advisable not to break them but to keep them for exhibition. In order to throw some light on the cause of the failure of some of the mortars to resist the action of the sulphates some density tests were made on the various mortars used in these briquettes.

On comparing the figures obtained for density wth the resistance of the mortars to the alkali solutions it was observed that in general for a given cement content the mortar with the lowest density disintegrated first.

In the cause of Standard Ottawa sand 1 to 3 mortar there is insufficient cement paste present to fill the voids in the sand. These briquettes disintegrated very badly. The neat cement specimens were practically unacted upon. One of the mortars on removal from the sulphate solutions showed a strength after 3½ months of 600 lbs. whereas the strength of same mortar in distilled water for same time was 360 lbs. Mr. Blackie advances the explanation that the calcium sulphate formed in the briquette is itself very strong and has added to the strength of the briquette but that in presence of plenty of water the sulphates would gradually be dissolved out and the briquettes would disintegrate.

To summarize the results of these experiments. As far as they have gone they seem to indicate that the action of the sulphates on mortar is proportional to the porosity of the mortar. In view of the fact that comparatively little time has been available to go into this matter thoroughly the results of these tests should be taken as pointing to a line of further investigation which should yield most interesting results.

Concrete in Alkali Soil in Saskatoon.

H. McI. Weir, M.E.I.C. assistant city engineer, Saskatoon, continued the programme by reading his paper published in advance form in the August issue of the Journal.

Observations of Concrete Failures.

This contribution to the literature on concrete was a report prepared by a Committee consisting of George W. Craig, M.E.I.C., city engineer, Calgary, G. C. Field, chemist, City of Calgary, F. W. Alexander, M.E.I.C., division engineer, C.P.R., Calgary, H. Sidenius, M.E.I.C., assistant engineer, Department of Natural Resources, C.P.R. and A. S. Dawson, chief engineer, Department of Natural Resources, C.P.R. Calgary, appointed by the Calgary Branch to investigate the subject, particularly in its relation to concrete as affected by alkali conditions. Before reading the paper, Mr. Dawson remarked that he believed that this question of desintegration of concrete was the most important to be discussed at this professional meeting, and suggested that steps be taken whereby the work already commenced to investigate this subject be continued, and that funds be acquired for that purpose. The paper follows:—

As far as published print would indicate the conditions arising from alkali-affected concrete and the theories regarding such are of comparatively recent date. The first literature seen by this Committee was published in 1908 by the Montana Experiment Station; and since that time the subject has been investigated by the Experiment Stations of Colorado and Wyoming, the United States Reclamation Service, and the United States Bureau of Standards.

The most causes of the disintegration of concrete may be summarized as,—

1—Bad Workmanship.

2—Poor and unsuitable materials, and badly graded and proportioned mixtures including the amount of water used.

3—Alternate wetting and drying out, and alternate freezing and thawing out.

4—Destruction and removal of the protecting outer skin from various causes.

5—The presence of an excess of alkali salts.

It is unnecessary to mention two effects of frost before setting, erosion of the skin by excessive velocities and other mechanical agencies; which to a great extent can be provided against during construction and subsequently, by various well known methods.

The following remarks apply to various structures in the City of Calgary, and in the country extending east between Calgary and Medicine Hat—all of which have come under the observations of the writers.

The aggregates were mostly (1) Bank run gravel, (2) River gravel. The cement was all Western brands, which had passed standard tests; and the water was from rivers and local wells. The workmanship was good, and all done under close supervision. The worst conditions have been found on types of structures whose design has necessitated their being backfilled on one side, and subjected to heads of ground water from the same direction—and at or below the original ground surface. These conditions seem to be aggravated where the structures are subjected to dry and wet surroundings—exposed to sun and shade in the winter months—excessive velocity—and where alkali salts are most in evidence and the ground wet.

The fact that the deterioration starts on the surface, extending inwards, and that the water being carried by the structures, has analytically been shown not to be responsible for the trouble, would indicate that the deterioration was primarily caused by the ground water, and its effects on the concrete. These effects vary in degree from the spalling off of the surface in what results in a pile of loose gravel below, to a condition where the mass becomes of a slimy consistency like so much lime mortar or mud. As a rule samples in what might be termed an intermediate stage get harder if permitted to dry out in the air, when they become coated with white powdery salts.

These observations have come from a committee who as individuals have had direct charge of over 250,000 cubic yards of concrete. The majority of the work is in first class condition; and the desintegration of a very small portion of the whole must be due to some extreme local conditions which exist at certain points where failure is taking place. The verdict has been pronounced by one of the most experienced chemists in the Western United States, Mr. Edmund Burke of Bozeman, Montana, who had been working with one member of this committee, that the desintegration is caused by alkali salts, and that the sulphates are the most active. This is the opinion of most of the men of the United States who have been working on the same problem for several years; although there is a difference of opinion as to just what change takes places. Either the desintegration is due to the formation of soluble compounds which are leached out of the concrete leaving it inert, or it is due to the disruption caused by the crystallization of the salts in the pores, or by chemical action of the substances in solution with the constituents of the concrete.

A brief study of the geological conditions of this part of Alberta shows that through the cretaceous period great deposits of clay were laid down in marine water, this deposit subsequently forming shale which contains considerable alkali salts. During the Tertiary Age glaciers swept over this country covering the clay to a greater or less depth with the present soil. Since the glacial epoch, erosion has carried away a portion of the glaciated material, and in some places, especially ravines and depressions, has left the shale exposed.

It is therefore probable that this shale and the clay soils derived from this shale carried the alkali salts found in several localities in which the structures were built. The glaciated soil gives little or no evidence of the presence of alkali. The structures placed in glaciated soil are therefore subjected to the least amount of alkali salts; while those placed in soils laid down during the cretaceous period are subjected to the greater amount of alkali salts. This is probably the reason why some of the structures are in perfect condition, while others are deteriorating quite rapidily.

Samples of soil were taken for analysis where concrete was failing, together with concrete both sound and showing different of desintegration, for the purpose of determining whether the soil adjacent to the structures contained sufficient alkali salts to account for the injury; and also to determine whether these salts had actually reacted with the concrete. The sulphates would seem to be by far the most active salts found, and it is generally admitted that magnesium sulphate is the most active salt found in alkali soils. The samples of soil were, therefore, analyzed for sulphates, which were subsequently calculated to sulphuric anhydrate (SO_3), and a composite sample for magnesia which was calculated to Magnesium Oxide (Mg0). Recent investigations by the United States Bureau of Standards show that porous tiles due to lean mixtures or relatively dry constituencies are disintegrated when exposed to water or soils containing alkali salts in quantities of 0.1 percent or greater. The Montana Experiment Station's work indicated that good mixtures of concrete were disintegrated when exposed to soil containing 0.4 percent or more of alkali salts. The soil must, however, contain sufficient moisture to allow for movement of the salts. Any condition which will tend to carry the salts from the soil to the concrete will hasten the disintegrating action, and lessen the percent of alkali necessary to cause destruction.

Table No. 1 shows the analyses of various samples of soil which were in contact with concrete structures where trouble has been experienced.

TABLE No. 1

Sample No.	SO_3 %		Mg0 %	Ca0 %
3	5.700		1.70	0.523
8	0.445	Comp.	0.63	0.210
12	1.190			
13	0.840			
15	1.930			
17	0.036			
19	0.888			
N.B. 1	0.690			
2	0.388			
3	0.543			
4	0.920	N.B. Comp		
5	.0.765		0.066	0.037
6	0.945			
7	0.566			
8	0.453			
9	0.508			
S.H. 1	0.386			
2	0.690			
3	0.588			
4	0.573			
5	0.550			
6	0.630	S.H. Comp.		
7	0.383		0.023	0.197
8	0.680			
9	0.468			
10	0.269			
11	0.194			
12	0.226			

Table No. 2. Analysis of Concrete showing percent of Lime (Ca0) and Sulphuric Anhydride ($S0_3$) and the Ratio of Ca0 to $S0_3$.

Sample No.	Ca0	$S0_3$	$S0_3$		Ca0
1	14.55	1.02	7.00	:	100
2	15.80	.30	1.90	:	100
4	9.44	2.44	25.8	:	100
5	12.56	4.65	37.0	:	100
5a	15.23	.72	4.73	:	100
6	12.84	3.90	31.6	:	100
7	12.11	2.85	17.0	:	100
9	12.96	3.65	28.2	:	100
10	15.41	.85	5.50	:	100
11	16.88	.52	3.09	:	100
14	15.52	.85	5.45	:	100
16	13.47	.44	3.26	:	100
18	14.89	.37	2.50	:	100
18a	21.60	.28	1.30	:	100
20	18.53	2.35	12.70	:	100

Inspection of this table shows that there are sufficient alkali salts in all samples analyzed to have a destructive effect on concrete of excellent quality. The samples of concrete were analysed for lime ($Ca0$) sulphates ($S0_3$) and magnesia ($Mg0$). The purpose of these determinations was to ascertain if the percentages of sulphates and magnesium were greater in disintegrated concrete than in sound portions of the same structure.

A study of Table No. 2 shows that the percent of sulphates is higher in the disintegrated concrete than in the sound concrete from the same structure; and this is well illustrated in samples Nos. 1 and 2, and Nos. 5 and 5a.

Sample No. 1 shows only a slight disintegration, but contains a higher percent of sulphate than Sample No. 2, which had not been acted upon by alkali. Sample No. 5 shows a greater degree of disintegration than sample No. 1, and contains a greater percent of sulphates. Sample No. 5a contains a greater percent of sulphates than sample No. 2. Samples Nos. 2 and 5a were taken from apparently sound concrete although it is quite possible that sample 5a represents concrete which was slightly acted upon.

Analysis of the same brand of cement as that used in the structures from which samples 1 and 5 were taken shows that the ratio of sulphates and hydrate of lime varied from 17.4 percent $S0_3$ to 100 percent $Ca0$ to 3.32 percent $S0_3$ to 100 percent $Ca0$. These ratios show less sulphate than was found in sample No. 5a.

It will be noted that there were smaller percentages of lime in the samples of disintegrated concrete than in the samples of sound concrete, and there is probably a slight leaching of lime from the disintegrated concrete, which would decrease its percent. A still further and more pronounced decrease in the percent is brought out in the accumulation of sulphate in the disintegrated concrete. The analysis of sample No. 6 shows clearly the effect which sulphates have on concrete, where we have a ratio of 31.6 percent of $S0_3$ to 100 percent $Ca0$.

Samples Nos. 7, 9, 10 and 11 were taken from a siphon. Samples 7 and 9 were taken from the outer surface of the siphon and show an accumulation of sulphates. Sample No. 11 taken from the inside of the pipe shows no accumulation of sulphates. Sample No. 10 represents the average material in the pipe barrel. It is interesting to note that the analysis of sample No. 10 shows a greater percent of sulphates than sample No. 11, but a much less percent of sulphates than samples 7 and 9. The analysis of sample No. 11 would indicate that little, if any sulphates were being taken from the water carried by the pipe. Sample No. 14 shows no disintegration, and the soil adjacent to this particular structure did not contain sufficient alkali to cause serious results. The same remarks apply to samples 16 and 18.

The following report on the analysis of stalactites taken from large structure should be interesting. This information is from O. E. Harder of the Construction Materials Research Laboratory, Lewis Institute, Chicago, and was corroborated in by J. A. Freeman, engineer, Technical Division, Portland Cement Association, Chicago.

Analysis. The chemical analysis of the sample of stalactite from Edmund Burke gate the following results:

Calcium Oxide ($Ca0$)	58.9%
Carbon Dioxide ($C0_2$)	29.5%
Loss on ignition ($C0_2$ H_20)	40.9%
Iron and Aluminum Oxides ($A1_20_3$ plus Fe_20_3)	0.5%
Magnesium Oxide ($Mg0$)	none
Sulphates ($S0_4$)	none
Reaction with Phenolphthalein.	Decidedly alkaline.

Combining the above medicals so that the carbon dioxide ($C0_2$) is combined with the calcium oxide ($Ca0$) to form calcium carbonate ($CaC0_3$) there is left an excess of calcium oxide which, when calculated to $Ca\ (0H)_2$ gives 28.2%. The calculated composition of the stalactite is:

Calcium Carbonate ($CaC0_3$)	67.1%
Calcium Hydroxide $Ca\ (OH)_2$	28.2%
Moisture by difference	4.7%

Conclusion. The above results indicate that lime is being leached out of the cement. Some of the calcium carbonate may come from the water which is coming in contact with the concrete. A water which contains lime and a considerable amount of bicarbonate ($HC0_3$) as this one does, may be expected to form stalactites due to the loss of carbon dioxide and the precipitation of calcium carbonate upon coming in contact with air and reduced pressure. Thus, $Ca\ (HC0_3)2 — CaC0_3H_20$ plus $C0_2$. However, it seems impossible that the calcium hydroxide $Ca(0H)_2$ could have been formed from the water. The water percolating through the concrete becomes saturated with calcium hydroxide which is slowly deposited forming the stalactites. Also, part of the calcium hydroxide deposited would be converted into the carbonate, due to the action of the carbon dioxide in the air. Thus, $Ca(0H)_2$ plus $C0_2{=}CaC0_3$ plus H_20.

If the leaching out of the lime continues and shows a tendency to increase, it may be expected to have a harmful effect on the concrete. On the other hand, if the leaching out of the lime shows a tendency to decrease, due to a filling of the pores in the concrete, slight or no harmful effects to the concrete should result.

In view of our observations the conclusion has been reached that we must get away from the idea that any ordinary foreman can handle concrete the way it must be handled. We have already revised our specifications demanding better workmanship—better materials where possible—richer mixtures with less water, and closer supervision by men who know the concrete business as a speciality.

We have already adopted the practice of using water gas tar and coal gas tar on the surface of walls which will be subjected to conditions which are known to cause trouble; but in this connection it should be noted that any asphaltic preparation becomes inert when subject to alkali salts, and that practically pure tars must be used. The best possible drainage facilities are also being provided at all structures built.

We have also started in on an elaborate series of experiments on concrete blocks 10″ x 10″ x 2′6″ using both Western and Eastern Cements with the following aggregates,—

A. Standard, e.g. screened, washed and graded.

B. Bank run, washed.

C. Bank run, natural.

Each in a 1–2–4– and 1–1½–3 mixture. The cement and water will be chemically analyzed, and put under standard tests. Sand and gravel will be analyzed chemically and physically. The blocks will be

1. Plain
2. Treated with soap and alum.
3. Treated with water gas tar and coal gas tar.

They will be placed in the best and worst localities that can be found, and will be systematically examined and tested over a period of 3 years or longer. It is anticipated that these investigations will help us as well as others who may work along the same lines, and be of value to the community at large. They may result, not only in getting at the root of the trouble, but enable us to determine on a mixture and class of work that will stand up and be most economical as well.

The attached set of photographs should be of interest, and show the conditions existing on some of the structures referred to herein.

In conclusion a brief summary of the original of alkali salts will be of interest to members who are not practical chemists.

The "Alkalis" as they are called are carried into the soil with the other elements, which form its inorganic bulk by the pulverization of rocks and minerals; the decomposition of inorganic sediment held in solution by water, by glacial action, seepage from rivers, and numerous other sources.

Oxygen acts on potash, soda, lime and magnesia and forms what are known as the "Alkali bases".

Oxygen unites with potassium and forms potash.
Oxygen unites with sodium and forms soda.
Oxygen unites with calcium and forms lime.
Oxygen unites with magnesium and forms magnesia.
but
Oxygen unites with silica and forms silicic acid.
Oxygen unites with carbon and forms carbonic acid.
Oxygen unites with phosphorus and forms phosphorus acid.

Oxygen unites with sulphur and forms sulphuric acid. These acids called metallic or mineral acids have a great affinity for the alkali bases forming "salts", and this is where the whole trouble about alkali soils begins.

These mineral or metallic acids attack the alkaline bases with the following results,—

Silicic acid forms silicate of potash, soda, lime and magnesia.

Sulphuric acid forms sulphate of potash, soda, lime and magnesia.

Carbonic acid forms carbonate of potash, soda, lime and magnesia.

Phosphoric acid forms phosphate of potash, soda, lime and magnesia.

It is the carbonate of soda, or what is commonly called sal-soda which forms what is generally termed "black alkali" and the sulphate of soda commonly called "glauber salt" which constitutes what is termed "white alkali". The numerous other salts are, of course, formed by combining the alkali bases and the mineral acids, but these are not so important in this connection.

When water is brought into the question the distribution of these salts is largely aided by the fact that the alkalis are extremely soluble in water. When these solutions are brought to the surface evaporation takes place and an accumulation of alkali salts becomes evident. As is commonly known these salts seriously affect vegetation if present in the soil in certain quantities, and are the ennemies which we will have to fight in order to save our concrete structures.

Methods of Proportioning Concrete based on recent Experimental Work.

Professor D. A. Abrams, Lewis Institute, Chicago, who is an expert on cement, was present, and gave the meeting the benefit of a masterly paper on the subject of proportioning concrete, as the result of experiments carried on in the Lewis Institute.

The complete paper by Dr. Abrams had not arrived at the time of going to press but will appear in a later issue. The following are a few notes on his address:

Sieve analysis of the sand and gravel used in mixing concrete has shown that many of the present ideas regarding the fineness of the sand, the size of gravel, etc., used are erroneous, and that maximum strength from concrete can be obtained only in making sure that the proportions of the various sizes of aggregate used correspond with scientific exactness to a standard which has been determined by experiment to be the best.

For instance, it has long been assumed that the proper basis for determining proportions was the surface area of the various particles mixed. Prof. Abrams' experiments have shown that the surface area does not give the proper relation, and has worked out a curve, based on the diameter of the particles, which shows the proportions of the various-sized particles which should be used to secure maximum strength.

The Proportions of Water

In connection with these experiments it was also shown that the amount of water used in mixing the concrete has a definite relation to the strength. Maximum strength is secured by using a certain amount of water, a deviation of ten percent on either the wet side or the dry side of this point will cause a drop of as much as twenty percent in the strength of the concrete. From this steep drop, the curve flattens out, on the wet side, until, with fifty percent too much water, the concrete has little more strength than so much mud.

The cause of this is that the increase in the amount of water increases the distance between the particles of cement, and when the chemical changes caused by hydration take place, if this distance is too great the changes will be confined to the separate particles and no general crystallization of the mass will take place. It was found after considerable experimentation that even the amount of moisture in the gravel, or its absorptive

powers, would be sufficient to cause a great variation in the strength. Generally speaking, the maximum strength of one-to-four concrete is secured by using about three-quarters of a cubic foot of water to every bag of cement used. This amount of water, however, is usually too small to make a workable mixture, and Prof. Abrams advised to keep mixtures as dry as was consistent with proper handling of the wet concrete. As to the variation in advantage between the "wet mix" and the "dry mix" he said the experiments showed this to be practically negligible.

At the conclusion of Professor Abrams' talk President Vaughan remarked that the series of papers given on concrete had added greatly to our knowledge of the subject, and while every paper was of foremost quality, he would draw special attention to the address given by Professor Abrams, which was the result of many years of research. This paper alone amply repaid anyone his trouble for attending the meeting. He proposed a vote of thanks to Professor Abrams for coming all the way from Chicago to give us the benefit of his observations. The proposal was carried with loud applause. He congratulated those responsible for drawing up the programme for securing papers of such unusual merit, remarking that one could attend many technical meetings without having the good fortune of listening to papers of such unusual interest as had just been presented. Referring to Mr. Dawson's suggestion regarding the establishment of a Committee, while establishing a precedent, it would be quite in order for this meeting, inasmuch as it was a meeting of the whole Institute, to recommend any proposal or draft up any resolutions suggesting action as a result of conclusions reached, but it would be necessary to have such forwarded to Council for approval.

The meeting now adjourned for luncheon, where the members, their wives, President Murray of the University, the staff, and visitors to the meeting, sat down to the number of about one hundred and fifty. Owing to the lateness of the hour when the morning session adjourned, and since the discussion on concrete was to be continued in the afternoon session, there was not sufficient time to have the Secretary's address, as provided for in the programme.

Fourth Session

2.30 p.m. Friday, August 9th.

On resuming, the President read letters from Premier Martin, of Saskatchewan, and from M. H. Macleod, M.E.I.C., general manager, Canadian Northern Railway System, Winnipeg, regretting that they were unable to be present.

Discussion on Concrete.

The discussion on the deterioration of concrete was opened by W. G. Chase, M.E.I.C., who said: "For six months a committee of the Winnipeg branch of the Institute has been accumulating information regarding this phenomenon, and as far as voluntary assistance could be obtained, has been directing a series of experiments as to the activity of soil alkalies and the resistivity to these influences on the part of various concrete mixtures. It is not desirable to draw a conclusion from the work done, but it seems fairly clear that porous concretes are liable to rapid deterioration, and that dense and inherently waterproof concrete are far less liable to it."

"In the effort to make a dense concrete, care must be taken to get a 'fat' mortar, and to carefully control the proportions of mortar to stony or coarse material. Bank-run is generally quite unsatisfactory, and from an economical standpoint quite improper. The proportion of sand to coarse material should be as low as 2.3 and preferably lower. The sand should not be sharp, but smooth or well graded, and well supplied with dust or fine sand. If shy in fine sand, then more cement must be used. A proportion of one of cement to three of sand will not give a dense mortar unless the sand be well graded; a one to two mixture is generally safe for the production of a dense mortar.

"The experience of the Winnipeg Committee has been very disheartening in their efforts to obtain the history of the structures which have failed, are failing, or are sound. Some instances, all too common, have brought out, however, the municipal practice of placing concrete in the cold weather, covering it with cold earth, and allowing the saturated ground waters to reach and penetrate the green concretes. All engineers should see that fully detailed logs of construction conditions are kept as work proceeds, and that these records are preserved.

"A simple test for the presence of sulphate in soils is to put a few drops of a barium chloride solution into an acidified filtered solution of the soil. With the presence of sulphates a characteristic cloud of barium sulphate will appear.

"This whole subject whould be studied systematically by an Association of owners, investors, public bodies and engineers."

A. G. Dalzell, A.M.E.I.C., Vancouver, having had very considerable experience with concrete sewer pipe, made the point that whereas all previous discussions had related to disintegration in alkaline soils, his experience showed that such occurred when no alkali was present. In Vancouver, where the soil is neutral, ten to fifteen miles of concrete pipe had been laid, and in some cases sufficient disintegration had taken place, not only inside but from the outside, to cause the pipe to collapse. This was no doubt possible because of faulty mix and manufacture. In some cases the outside of the pipe was soft, and the interior quite hard. In sewers it is impossible to get rid of the ground water and prevent it coming in contact with the sewer pipe. This is a serious matter. The whole situation emphasizes the necessity for a thorough investigation being undertaken by some group of organizations of which the engineers should be a part. Professor Duff Abrams considered that the discussion should not be called "disintegration of concrete" but "defective concrete." It showed at least that concrete at all times should be good concrete, and if subjected to water should be as nearly waterproof as possible. That means good materials, proper proportion, proper methods of mixing, placing the concrete, and curing. Now improper attention to any one of these factors is

very likely to be disastrous, and that is particularly applicable to structures of concrete roads and other areas that are exposed to evaporation. Unfortunately manufacturers of sewer pipe and drain tile do not always take into account the proper proportions and proper mixtures. The mistake is frequently made by using bank run material. Now if concrete is made with a very large excess of water it is never going to be a good concrete. The opinion has been expressed by a great many people that this concrete will attain the same strength as other concrete, but we have not found that to be the case. Furthermore, a water environment should be the very best condition for curing and hardening concrete. His own experience had shown that concrete samples left in water for four years showed no deterioration whatever, going to prove that if concrete is properly made in the beginning, a water environment should not be unfavorable. In the early days, in building foundations, sufficient care was not exercised in placing the footings, and this is the cause of considerable trouble. While not authorized to speak officially, he assured the gathering that the Association of Cement Manufacturers would be glad to co-operate with the Western branches of the Institute, or with any Committee which might be formed, with a view to assisting in a thorough investigation being made of this problem, as all must realize that this is a most important problem. The Association would welcome the inauguration of a movement to cover the matter in a comprehensive way. George W. Craig referred to instances of defective concrete that had come under his attention at Great Falls, Montana, as far back as 1907. There, however, not only were concretes attacked by the alkali, but brick and sandstone. In some instances both the brick and the sandstone had become so soft that they could be crumbled in the hand.

Resolution.

After some further discussion, on motion by A. S. Dawson seconded by W. G. Chace, and carried unanimously, it was resolved

> *That the Council be requested to appoint a Committee of the Institute to be known as the RESEARCH COMMITTEE ON THE ACTION OF THE ALKALINE SALTS ON CONCRETE to carry out such experiments and investigations as they consider desirable, with power to collect funds in the name of the Committee to enable them to carry out their work.*

FUEL.

The paper by James White, M.E.I.C., having been published in the *Journal* and also in pamplet form by Mr. White himself, was abstracted by him, with some additional information in relation to the fuel situation. Mr. White presented some interesting maps of Western Canada, showing the coal areas, and pointing out the districts where gas was available and where there was a likelihood of securing petroleum. He outlined the reasons for the coal shortage in the United States, and pointed out the difficulties experienced by fuel controller C. A. McGrath, M.E.I.C., in overcoming misconceptions regarding the fuel situation.

The Secretary expressed the regrets of R. A. Ross, M.E.I.C., who was unable to be present to read his paper on the Briquetting of Lignites, and inasmuch as this had already been published, it was taken as read.

Experience with the Combustion of Lignites.

E. C. A. Hanson, A.M.E.I.C., then read his paper on this subject.

Many papers have been prepared and read, as to the composition of our fuels, and as to the results obtained under test conditions, but not many have told of the results obtained under operating conditions, or of the methods and necessary changes adopted for the efficient combustion of our local fuels.

Apart altogether from the national crisis which has made necessary the immediate use of our fuel resources, it is right that we should know what already has been done towards increasing the use, and in addition, to utilize a larger percentage of the total output of our mines, with an estimated deposit of 2,412 million tons of lignite in Saskatchewan, our yearly production up to date has only reached the modest amount of 250,000 tons. This surely indicates the urgent necessity for familiarizing ourselves with the methods necessary for the efficient use of this fuel.

The lower grade lignites have a higher moisture content, and slack readily when exposed to the weather for any length of time. The slacking of this fuel has been a serious drawback its to general use, chiefly because facilities have not been available for efficiently storing and burning it, consequently it has been somewhat troublesome to handle. Then again, it is generally understood that coal greatly deteriorates in heating value when it has slacked, whereas, the facts are that the loss in heating value is a negligible quantity.

The biggest factor militating against the use of this fuel, and which must be overcome before it can be efficiently converted to thermal or mechanical energy, is the fact that almost all steam plants and furnaces in this western country have been installed on the basis of use with Eastern or American high brade bituminous or anthracite coal, and they will have to be replaced or altered to suit the conditions necessary for the combustion of lignite, i.e., high moisture, high volatile fuels.

Such was the condition existing at the Saskatoon plant at the time when we commenced our experiments to determine whether it was possible to utilize the lower grade fuels economically and still maintain a high enough boiler capacity for our needs. When it is remembered that we have the before mentioned enormous coal deposits in our own province, the mistake of not taking local fuels into consideration before designing a boiler plant is shown by the enormous sums paid for freight by one of this city's departments in three years:—

Year	Total Fuel Cost	Freight	Fuel
1913	$145,509	$83,155	$62,354
1914	104,230	68,302	35,928
1915	86,745	69,044	17,701
	$336,484	$220,501	$115,983

or, in other words, 65.5 per cent of the toal amount paid for fuel, covered the freight charges, while the remaining 34.5 per cent was the actual value of the fuel at the mine.

The boilers were equipped with Babcock & Wilcox chain grate stokers, with the usual semi-dutch oven setting and vertical bridge wall. The dutch oven roof was horizontal with an eight inch spring in the arch. With this setting it was found impossible to ignite the lower grade fuels closer than from 18 to 24 inches from the grates, the distance increasing in direct ratio to the grate speed, and also increased as the moisture content in the fuel increased, till, with a fuel having a higher percentage than 17, it was impossible to get results in boiler rating which would warrant its use, and even with 17 per cent moisture, it was a common experience to have our fires go out. These experiences led us to the conclusion that an ignition arch situated in the path of the hot gases, and inclined so as to reflect directly forward on the incoming fuel, was necessary. It was also found that by introducing a reflecting arch in the old setting, the temperature of the grate was increased very considerably, also, the effective grate surface was reduced, owing to the arch maintaining the ash and refuse above fusion point. This created a bed of clinker which caused a great deal of trouble in its removal, and, owing to the fact that this accumulation had to be removed by means of the inspection door, the furnace temperature was considerably reduced, and combustion was adversly affected, reducing also, the possible steaming capacity.

But it was impossible to introduce an arch which would reflect far enough forward on the incoming fuel with the old setting, therefore, we cut down the dutch oven, as shown on the accompanying blueprint, inclined the front arch, thus allowing the heat from the second arch to be reflected directly on the incoming fuel. This setting also allowed of a larger radiant fuel bed being exposed directly to the boiler tubes, owing to the fact that the grates were carried further back and the bridge wall inclined so as to meet and maintain the baffle in the old position.

The net result of these alterations was that the boiler capacity was increased from 50 per cent of builders' rating, to 150 per cent with the same fuel; also, the burning of lower grades was made possible, but here again the freight rates were the determinating factors and the fuel which gave us the most efficient results had an analysis as follows:—

Moisture	16.2 %
Ash	9.05%
Volatile Comb	31.51%
Carbon	43.24%

Calorific value as fired 9920 B.T.U.

For obvious reasons it is not permissible to give here the test results. Suffice it to say that under test conditions the difference between the results obtained before and after the changes were made was not great. The most important reason for these results being, that the conditions under which the tests were run were the conditions which gave the highest $C0_2$ and highest evaporation per lb. of combustible, and not the conditions which permitted the highest rate of combustion, and therefore the highest steaming capacity. The net result of these experiments is shown clearly when reports on coal costs in the plant for the years 1913, 14, 15, 16 and 17 are examined, these are:—

Fuel costs per K.W. output

1913	1914	1915	1916	1917
1.66	1.36	1.02	.839	.843
8,723,389	8,875,642	8,456,910	9,425,570	11,096,750

Until the year 1917 we did not have instruments to give results in pounds of steam per pound of fuel consumed, so that all our results were based on k.w. output. There are other factors which would affect calculations on this basis under test or short runs, but over the year, these factors average about the same, so that the comparisons are fairly accurate, and should be a fair basis for other plants to estimate possible results to be obtained from the use of our local fuels as against the higher grade fuels.

I attach herewith, blueprints which show clearly, the alterations to the furnace settings; also a blueprint showing the original setting.

The successful results obtained by these alterations definitely settled several fundamental conditions which must be obtained before lignite coal can be used satisfactorily. Mr. J. R. Cowley and myself worked them out and applied them to a small furnace, which can be applied to hot air, hot water or steam heating apparatus, as per the attached blueprint No. 2, and to horizontal return tubular boilers, also as per blueprint No. 3. The results in both cases exceeded our expectations.

The objections to the old type furnaces in common use are that:—

(1) A large portion of the volatile matter passes up the chimney unconsumed.

(2) A large percentage of the combustible matter finds its way into the ash pit.

(3) Danger from explosions, due to lack of knowledge or care in firing, but even when precautions are taken, the danger is not entirely removed.

(4) Nuisance caused by soot and smoke.

(5) Too much time and attention must be given to the furnace.

(6) Furnaces are not adapted to burn screenings or small coal.

By reference to blue print No. 2 it will be seen that the essential features of the furnace are, a brick lined case having a fuel hopper attached, communicating with the inclined grate by a carbonizing chamber, the grate terminating in an ash dump; a baffle disposed above the grate in such a fashion that the gases of combustion are directed against the carbonizing chamber so as to raise the temperature therein to a degree sufficient for the evaporation of the moisture content, and the distillation of the lighter volatile gases which pass through the aperture in the front wall, after which, they pass the hot air inlet; the air being preheated to approximately the gas temperature an almost perfect mixture takes place. The carbonized fuel feeds down the grate by gravity until nothing remains but ash on the dump plate.

It will be noted that we have met the objections enumerated above in that there is no large volume of the volatile gases passing in the form of smoke up the chimney.

(2) It is almost impossible for combustible matter to find its way into the ash pit.

(3) It is not possible, under these conditions to have any danger from explosion, neither is it necessary to have any expert knowledge of firing, or to take unusual precautions owing to the fact that an almost perfect mixture of air and volatile gases takes place in the combustion chamber.

(4) For the same reason the nuisance caused by soot and smoke is eliminated.

(5) The objection of frequent attention is met by the fact that there is a hopper attached to the furnace which will carry sufficient fuel to last from twelve to eighteen hours.

(6) While the grate shown, makes it possible to burn small sized coal or screenings, there is no possibility of any quantity of fuel falling through into the air chamber.

By reference to print No. 3 it will be seen that the design is practically the same, the only alteration being the adaptation to different conditions.

In conclusion, gentlemen, I might add that Dr. McLaurin, who has conducted the tests which have been carried out on the domestic furnace, and who has helped very considerably in its development to its present form, is here to-night, and will gladly go further into any details which any of you gentlemen may enquire about.

A supplementary paper on the subject of Suggestions for Efficiently Burning Lignites in a Domestic Furnace, was read by the author, Professor R. G. McLaurin, Professor of Chemistry, University of Saskatchewan.

Suggestions for Efficiently Burning Lignites in a Domestic Furnace.

There has been a great deal of discussion on in regard to the fuel situation during the past year and the government has endeavored to grapple with the problem of fuel production and distribution, but little attention has been paid to the control of fuel by efficient methods of combustion. Nearly all the coal in Canada is burned directly in air, consequently the most efficient methods of burning fuel are of momemtous national concern as it is generally conceded that 25% of coal is wasted through inefficient methods of combustion. This waste at $8.00 per ton would represent an annual loss in Canada of $60,000,000. It is known that a very large percentage of the output of mines is lost to the mine operator in the form of screenings, as a profitable market is limited. Both of these wastes constitute serious economic problems and knowing these facts the logical method of attack is to devise means for burning more efficiently fuels which are in general use and also to develop methods for burning low grade fuels which have not been used to any extent heretofore.

Western Lignites.

The lower grade lignites have a high moisture content and readily slack when exposed to the weather for any length of time. The slacking of this fuel has been a serious drawback to its general use, chiefly because facilities have not been available for storing it and efficiently burning it, consequently it has been more troublesome to handle. Then again it is generally understood that coal greatly deteriorates in heating value when it has slacked, whereas the facts are that the loss in heating value is a negligible quantity. To overcome these objections, attempts have been made to carbonize lignite and briquet the residue. Carbonization undoubtedly is the most economical method of treating coal with high volatile content providing economic conditions are favorable for the disposal of the by-products. However the carbonized residue is an excellent domestic fuel and can be burned with perfect ease and satisfaction in the proper design of furnace, so there does not seem to be any real necessity for briquetting the carbonized residue and thereby adding additional cost to the fuel. It will be argued that in order to burn lignite satisfactorily that it will be necessary to instal new furnaces. That argument is correct, and it will be good business to instal new furnaces unless a domestic fuel can be put on the market considerably cheaper than anthracite ever has been in the past.

Value of Fuels.

The value of coal is too frequently determined on a b.t.u. basis solely. The number of b.t.u.'s per pound that the coal contains is unquestionably an important factor but it is only one. A knowledge of the quantity and constituents of the volatile matter of coal, as far as actual value is concerned, is more important than the number of b.t.u.'s it contains, as the constituents of the volatile matter are much more valuable for other purposes than for fuel. Also the nature of the volatile matter and fusion point of the ash are very important factors from the standpoint of complete combustion. The value of coals for heating purposes must be determined by the relative quantity of heat which may be obtained under operating conditions. A coal producing ash which clinkers badly may not be as valuable a fuel as one which forms no clinkers and contains fewer heat units. The amount of combustible matter in the ash in ordinary furnace practise frequently exceeds 6% of the total weight of the coal. At the present time certain people think that anthracite is the only domestic fuel at any price. If fuel costs compared with anthracite can be reduced 40% by burning satisfactorily raw lignite or its carbonized residue, the probability is that the importation of anthracite coal will not continue many years.

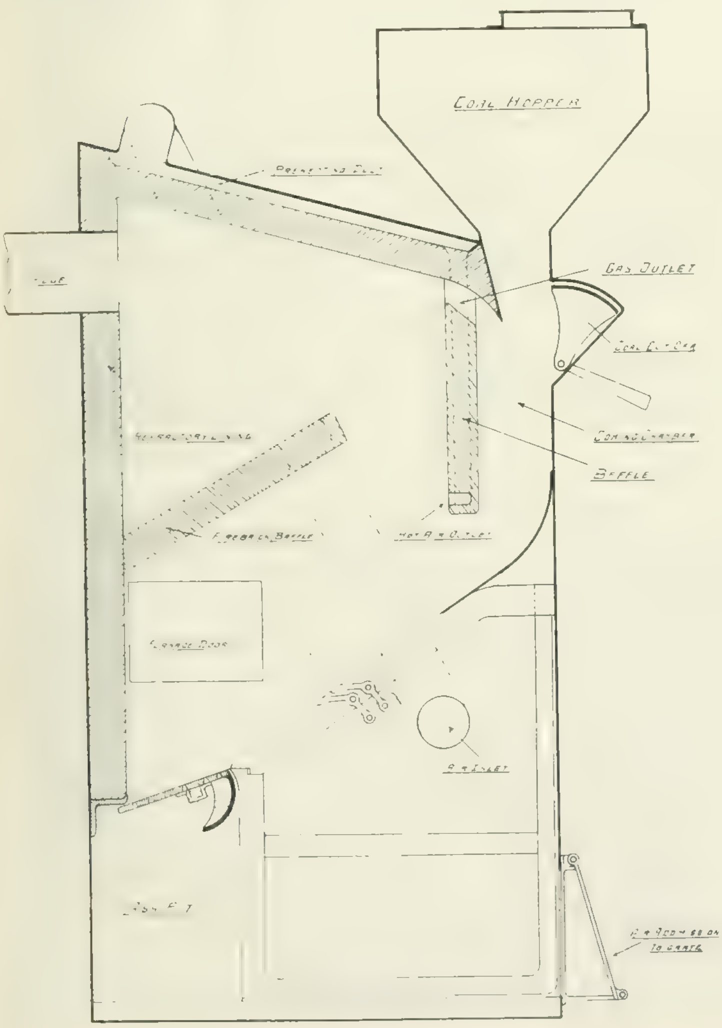
It is recognized that most of the domestic furnaces which are on the market are not suitable for burning western coals satisfactorily. It is true that lignite can be sluggishly burned in an ordinary furnace providing one is an expert fireman. The chief objections to the furnaces in general use for burning lignite are:—

1. A large portion of the volatile matter passes up the chimney unburned.
2. A large percentage of the combustible matter finds it way into the ash pit.

3. Danger from explosions—due to lack of knowledge or care in firing, but even when precautions are the danger is not entirely removed.
4. Nuisance caused by soot and smoke.
5. Too much attention and time must be given to the furnace.
6. Furnaces are not adapted to burn screenings, or small coal.

Since most of the furnaces which are on the market are not suitable for burning our Western coals efficiently it is obvious that furnaces should be constructed which will burn them satisfactorily.

E. C. Hanson, A.M.E.I.C., consulting engineer, Winnipeg, some three years ago, recognized the vital importance of divising means for burning lignite coal efficiently. To accomplish this object a system of arches was installed in the power plant at Saskatoon and the results obtained have exceeded expectations. The principles which were established in the power plant were then adapted to a domestic furnace by Messrs. Hanson and Cowley and the furnace was tested out thoroughly by the writer last summer.



Furnace for Lignite Coal.

The essential features of a furnace for burning lignite or its carbonized residue are:—

1. Carbonizing chamber,
2. Combustion chamber,
3. Introduction of hot air into combustion chamber,
4. Inclined shutter grate so constructed that screenings and dust are prevented from escaping into the ash pit.
5. Coal hopper of sufficient capacity to keep furnace operating twenty-four hours on two charges,
6. Dump grate so constructed that ash may be dumped while live coal is retained on inclined grate,
7. Rear arch inclined so as to reduce temperature on fuel bed and thus prevent or at least greatly reduce the possibility of clinker formation,
8. Constructed so that coal will be readily ignited and burn continuously thus maintaining a uniform temperature over a long period of time,
9. So constructed as to prevent the possibility of soot or smoke forming,
10. Precautions taken to have a thorough mixture of combustible gases and hot air and thereby attain complete combustion and remove all danger from explosion.

Operation of Furnace.

A wood fire is first kindled on the dumping portion of the grate and then coal of pea size is gradually added to the hopper until the grates are covered to a depth of about four inches. The depth of coal in the fuel bed can be regulated by the gate at the bottom of the hopper. The coal is readily ignited and as the flame passes up over the surface of the inclined fuel bed it becomes red hot in the course of 30–45 minutes. The feeding of the furnace is automatic with coal of pea size. Practically all the western coals have been burned satisfactorily and no difficulty has been experienced with the gravity feed. It is not desirable to use coal of stove or nut size as the free movement of the coal down the hopper is retarded but coal of pea size or screenings gravitate without interference.

The time necessary to devote to a furnace is an important factor. One of the serious objections to most of the furnaces is that it is necessary to fire frequently during the day and night. With this new furnace it is found that a good fire can be maintained continuously in the furnace by filling the hopper twice in 24 hours. This point was established with Souris coal as it is generally considered to be one of the lowest grade fuels. Fire has been maintained in the furnace with Souris coal for eighteen hours without attention and relighted by dumping the ash and adding fresh coal.

In burning the various western coals no trouble was encountered with the formation of hard clinkers. In our earlier experiments the rear arch of the furnace was parallel to the fuel bed, and with one sample of coal in particular hard clinker was formed, but it was found that by tilting the arch slightly upwards and increasing the space between the arch and fuel bed that the tendency

for clinker formation was considerably reduced. With the furnace as constructed at present the clinker which does form from Western coals is of a porous nature and is easily disposed of by the dumping grate.

Dumping the Ash.

The temperature on the dumping grate is lower than that on the inclined grate, and after the fire has been burning all day the ash becomes comparatively cool and may be dumped without loss of live coal. The dumping grate carries a circular plate attached to its lower side in close proximity to the shutter grate so when the dumping grate is inclined forward the ash falls into the ash pit and the circular plate prevents the hot coal from gravitating forward into the ash pit. A number of different forms of dumping grate have been experimented with but the form as described works most satisfactorily. The best burning results are obtained by keeping the hopper supplied with coal, regulating the air mixture, dumping the ash when it forms, and avoid shaking the inclined grate.

How Air is Supplied.

Air is admitted to the fuel bed chiefly through the dumping portion of the grate which is perforated with one quarter inch holes. The steps comprising the inclined grate overlap each other and fit very closely together so that the air spaces are very small, consequently most of the air which passes over the fuel bed is taken in through the dumping grate. The best results were obtained with a limited air supply through or over the fuel bed, and just sufficient air was admitted at low velocity to gasify the coal. The combustible gases were burned in the upper chamber by introducing hot air into the lower part of the combustion chamber at approximately the same temperature as the gases. Under these conditions a very thorough mixture of air and combustible gases is secured and consequently complete combustion.

Prerequisites for Efficient Combustion of Western Coal.

1. *New Furnace Design.*

Furnace design of such a nature that combustible in the ash will be reduced to a minimum and also prevent the escape of combustible gases up the chimney. In general practise the amount of unburnt carbon in the ash varies with different fuels, furnaces, operators and fusion temperature of the ash, consequently uniform combustion results are very difficult to obtain if not impossible. With the furnace as described more uniform results can be secured by any operator, and combustion is as nearly complete as can be obtained by burning fuel on grates.

2. *Control of Combustible and Air.*

The control of combustible and air in a domestic furnace is a very difficult problem. Whenever fresh coal is added to the fire the temperature of the furnace is lowered and a large part of the volatile matter of the coal escapes up the chimney before the temperature of the furnace is again high enough to ignite the gases, and further the mixture of air with the gases is very imperfect. In this new type of furnace the carbonizing and gasification of the fuel is gradual and continuous as the feed is automatic. The fuel bed on the inclined grate is always red hot and thus a high temperature in the furnace is maintained. By introducing hot air under control into the combustion chamber complete oxidation of all the volatile matter is obtained. Burning tests have been conducted on practically all the western coals marketed and the fuel can be burned so that no carbon monoxide or hydrocarbons are found in the flue gases. Using Pembina coal the average percentage of carbon dioxide during a 3 hour period was 16.2%; the maximum percentage of carbon dioxide was 17.3%. These results indicate very complete combustion of the volatile matter and it was found that the combustible in the ash, particularly from Souris Coal, is practically negligible. The temperature in the combustion chamber from Souris coal reaches a maximum of 2100°F. Other western coals give higher temperatures.

In the April 30th number of "Power" an experimental lignite furnace for domestic heating is described by Kreisinger of the Bureau of Mines, Washington. In his article on "Combustion of North Dakota Lignites, With suggestions for Design of Furnaces" he states that "In fact it seems that the carbonized residue when burned in this special type of furnace would make an ideal fuel for house heating purposes".

Since the furnace described by Kreisinger is in many respects similar to the original furnace patented in Canada and the United States over a year ago by Messrs. Hanson and Cowley and having conducted a large number of burning tests with this furnace it may not be amiss for the writer to discuss the relative merits of the original furnace, which was similar to the one Kreisinger described and the new design.

From the writer's experience in operating the two furnaces, the new design has several practical advantages over the original furnace. Firstly—the easy disposal of the ash without dumping the fire is an important consideration.

This was found difficult with the horizontal dumping grate in the original furnace. If the fuel bed on the inclined grate remained in position until the ash was dumped there was no particular difficulty except when clinkers formed. When agitating the grate to break the clinker there was sufficient vibration created to start the fuel gravitating on the inclined grate which, of course, was not desirable. After experimenting with a number of different forms of grate, the slightly inclined dumping grate carrying a circular plate, has proved satisfactory as it greatly facilitates the dumping of the ash and clinker. Secondly—it was found that when the rear arch paralleled the fuel bed too closely there was a greater tendency for clinker formation than when the distance between the arch and full bed was increased and the arch tilted slightly upwards. As the flame passes over the surface of the fuel bed it is directed upward and away from it, so the heat is not reflected to the same extent. The clinker always forms on the surface, so any device which will tend to lower the temperature at the surface of the fuel bed, below the fusion point of the ash, will assist in the prevention of clinker forming.

Thirdly—air introduced through the grate and coal hopper is difficult to control. By allowing a limited amount of air to pass through the grate and then conducting hot air under control into the lower part of the combustion chamber it was found that the fire could be regulated with greater ease. By mixing the combustible with hot air the second stage of the combustion is more complete within a shorter space than was experienced in the original furnace.

Fourthly—the exit flue for the gases has been changed from the top to the upper end of the combustion chamber. This alteration was made so that air could be pre-heated in a space above the combustion chamber, and furthermore the gases have a greater distance to travel which makes it easier to control the length of flame. As the boundary of the flame signifies the zone of combustion the completion of the oxidation is readily cdetermined. The length of the flame on the thoroughness of the mixing of the air and gases and also on their velocity. However in the new furnace no difficulty was experienced in confining the flame to the combustion chamber and still maintaining high temperatures. With a short flame and low velocity of the gases there is little tendency for the fine ash to be carried into the flue.

Fifthly—As far as the position of the hopper is concerned there is no material difference in the two furnaces, as one delivers the coal just about as readily as the other. The hopper on the new design is kept air tight, which has proved an advantage in regulating the air supply and consequently controlling the fire. The air tightness has further proved advantageous in maintaining a lower temperature in the hopper, and preventing the escape of gas. Certain coals may be burned continuously and the hopper remain quite cool, while others becomes slightly warm, but no practical difficulty has been experienced with the coal igniting in the hopper as the air tightness minimizes such a possibility.

The object of this paper is merely to present such facts which may establish the practicability of successfully burning low grade fuels or their carbonized residue in a new design of domestic furnace.

Opening the discussion for the Calgary Branch, William Pearce, M.E.I.C., showed a blueprint which illustrated the coal situation on the prairie provinces in its relation to production, export and import of coal. He had given the question of fuel some consideration and, believed that the use of pulverised coal would have an important bearing on this problem in the future.

At this point of the proceedings, E. J. Stone, secretary of the Canadian Railway War Board, arrived and read a paper which was to have been given by W. B. Lanigan, assistant freight traffic manager, C.P.R. on "The Transportation Feature of the Coal Situation."

The Transportation Feature of the Coal Situation.

In dealing with this question, I have confined myself mainly to the situation as its exists in the western prairie provinces, as it is in these provinces that it assumes its most acute form. In the eastern and mountain sections of the Dominion, except in the larger cities, wood can be, and is, used to a large extent to relieve a shortage in the coal supply, but on the prairies there is nothing to take the place of coal. Straw is to some extent used for firing threshing engines, but it is not adaptable in its present form for domestic use. Therefore in winter, if the supply of coal is short, the prairie town and country dweller is faced with a desperate situation. It is chiefly to the credit of the railways that there has not in past years been much suffering due to a lack of this necessary commodity, as it can be stated generally, that with the exception of the United States coal which has been annually brought in and stored by the railways at the lake head, and the coal which the railways have stocked at various points for their own use, there has been in Western Canada, practically no stocking of coal during months favorable for its transportation, to provide for severe weather conditions. This has placed upon the rails ways the burden of handling a heavy coal tonnage during the worst weather,— a tremendously difficult and costly operation.

Insofar as Canada, east of the great lakes is concerned, there are only two features which alter the situation to any extent over past years. The first is the enormous traffic with which the railways are now burdened, which of course adds to the difficulties experienced in handling coal, and second, the limitation in the allotment of United States coal to that territory, which will no doubt be reflected in an increased movement of wood in some sections.

The situation has not altered in British Columbia, where the comparatively limited demand is met locally.

It is in the provinces of Alberta, Saskatchewan and Manitoba, and particularly in the two latter, that the situation takes on its difficult aspects. To a very large extent Manitoba, and eastern parts of Saskatchewan, have in past years depended for their fuel on the supplies of anthracite brought in by lake and rail from the United States. The transportation of the winter's coal supply from western mines places upon the railways a tremendously increased burden.

It is almost an impossibility to deal with this question statistically with any degree of accuracy. There are no statistical bases of comparison between the situation in Western Canada in past years, and the situation as it exists today.

In considering this matter from a transportation standpoint, I will take Winnipeg, the point which is most greatly affected by the change, as an illustration.

During the year 1917 the city of Winnipeg consumed a total of approximately 457,000 tons of commercial coal, of which about 215,000 tons was anthracite, 222,000 tons bituminous, and 20,000 tons lignite. The bituminous supply has not been greatly disturbed, but the Fuel Controller has stated that not more than fifty percent of last year's anthracite supply will be available this year, which means that, allowing for the difference in efficiency between anthracite and lignite, Winnipeg will have to receive from the western mines about 200,000 tons. As the railways cannot be expected to maintain the movement at full capacity after the commencement of the heavy grain movement, this means that from May 15th to October 1st, a period of 138 days, coal should have been coming into Winnipeg from the west at the rate of 50 cars per day. As a matter of fact it has not been coming

in anything like that quantity. During the month of May in the average number of cars to arrive Winnipeg daily was 13; in June 29 cars arrived daily, and in July 27 cars. During the week ending July 14th, there were shipped to the city of Winnipeg from all mines in Western Canada, 217 cars of coal, or an average of 31 per day. During the week ending the 21st, there were shipped a total of 252 cars, or an average of 36 cars per day. During the ten-day period ending July 31st, there were shipped a total of 333 cars, an average of 33 cars per day.

While these figures are typical of a section of the province of Manitoba, they are not so of Saskatchewan, where stocking of western coal has been fairly heavy, and into which province, shipments for the three weeks prior to July 31st, averaged over 125 cars per day.

From May 15th up to the end of July, all the mines in Western Canada, shipped to all points, of all classes of coal, a total of 1,238,000 tons, as compared with a total of 592,000 tons shipped in the same period last year, but the figures mean very little when it is remembered that last year from early in May until about the first of July almost all the coal mines in Alberta had strikes on their hands. In addition a very large proportion of the increase is made up of steam coal stocked for railway purposes.

Winnipeg's anthracite supply, brought in during the lake navigation period to the lake head, was, in railway movement distributed over a period of eight months. By far the greater portion of it, however, was handled during the months in which the grain was moved to the lakes, giving the railways a westbound coal movement to Winnipeg, and to some extent beyond, corresponding with the eastern grain movement, and thus limiting in some measure, that bane of the transportation officer — empty car haulage. Now look at the situation created by the substitution of Western coal for anthracite. This must be brought from mines located an average of 900 miles from Winnipeg. It must largely come down in a period of approximately four months. It must be handled in the same direction with the preponderance of traffic during the greater portion of the year, meaning an empty car hauled for nearly every car of coal brought in. Where to bring in a car of coal from Port Arthur or Fort William only meant the loaded car haul of 420 miles, to bring one in from the western mines means an empty car haul from Winnipeg west of 900 miles, and as, during the grain shipping period which extends over a considerable portion of the year, every car sent west from Winnipeg for coal loading necessitates an equivalent empty movement from the lake head to Winnipeg, the total empty haulage for each car of western coal brought to Winnipeg is 1,320 miles. Add to this the return loaded haul of 900 miles, and you have a mileage of 2,220 per car, or over five times the distance is covered to bring a car of coal to Winnipeg from the western mines than was covered to bring a car from the lake head. The car efficiency is actually reduced by more than five times, because the western railways, between Winnipeg and the western mine territory, all operate through a section of prairie country where the scarcity and poor quality of the water reduces locomotive efficiency, and makes railway operation at certain seasons very difficult and costly.

The greatest movement must be crowded into a period of four or five months because during the latter part of September, and the months of October and November, when the bulk of the crop is moving out, the railways cannot undertake to move coal from the west in any quantity, and at the same time discharge their essential duty as grain carriers.

The very fact that the bulk of the western coal must be moved during the summer months, however, would if taken advantage of, to a slight extent offset the disadvantages referred to, as that is the period when the railways in the west have usually had a surplus of men, power and cars, and weather conditions are most favorable to an uninterrupted movement.

Under the conditions created by the necessity for bringing the coal supply from the west, a feature upon which too much stress cannot be laid, is that of capacity loading of cars. Practically all of the railways in Canada, as a result of exhaustive tests, have increased the loading capacity of their cars beyond that formerly allowed, as high, in some cases, as twenty percent, basing it upon the carrying strength of the axles. Loading cars with all they will carry in the direction of the preponderance of traffic increases transportation efficiency enormously, and the Canadian Railway War Board has been urging upon all shippers the importance of giving attention to this feature. It is one way in which the railways can be assisted by the shipping public to give better service to that public.

The railways were early in the field to assist in improving this season's fuel situation. Through the Canadian Railway War Board they have entered into all movements looking to a solution of the problem. On their behalf Mr. Grant Hall, Chairman of the Administrative Sub-Committee of the Canadian Railway War Board, at a meeting which was held in Calgary on February 11th, gave assurance that the railways would be prepared to handle all the coal offered up to the commencement of the grain movement, and Mr. W. P. Hinton, representing the Administrative Sub-Committee repeated this assurance at a meeting held in Ottawa on April 18th, and they have not failed to do this. Steps were taken by the railways to begin at once to stock all the railway steam coal which the mines could turn out, in order to free railway facilities for handling domestic coal later on. Empty cars, which, accumulating in the East as a result of the winter all-rail grain movement, are usually moved west gradually throughout the summer, as traffic conditions permit, were in early spring handled west in train loads, and an uninterrupted full supply of cars has been maintained at all mines throughout the spring and summer, with a surplus always available to meet any needs which might arise.

It is not the intention to criticize the efforts of anyone else, but the movement of coal from the west has not, up to the present, been what the railways had hoped for, and were led to expect. There are several reasons for this, chief among which, I imagine, are, first the difficulties experienced by the mines in securing labor, and in getting full-time work from that available, and second the fact that certain of the western coals will not stand outdoor storing without deterioration, making the dealers

hesitate to stock it in any quantity. Consumers, notwithstanding repeated warnings, have not laid in as much as was hoped, due, in some measure, no doubt, to the difficulty in financing at once a whole or considerable portion of a season's supply.

More than any other large employers of labor the railways have found it difficult to secure capable employees to take the place of those who either voluntarily enlisted or were called to the colors. Those classes of employees whose duties are connected with the movement of trains must be of high standard, and some of them must be trained for years before they can be entrusted with the lives of passengers and fellow employees.

Troop movements and heavy traffic of an emergent nature due to the war have made their demands on the railways. They have met these and will continue to meet them. If a coal shortage should develop this coming winter, it will not be because the railways have failed to do everything in their power to prevent it.

Discussion on Fuel.

G. R. Pratt, of Winnipeg, opened the discussion on the subject. He pointed out that it was not made clear that the furnace described was designed for high grade fuel as well as low. Referring to a diagram he indicated the possibility of getting heat to a boiler from a grate five feet distant; stating that in order to demonstrate this fact it had been necessary to discharge the fireman operating one of these furnaces, doing the work himself for a few days, and that the results had been satisfactory. He was unable to give the results of observations in Calgary, but drew a diagram illustrating the type of furnace being used. Professor Greig, Saskatoon, referring to one point brought out in the papers, stated that results at the University buildings had made patent the fact that coal could be mixed to advantage. They were burning slack entirely, and from records kept, in the years 1914-15, they found — from the dollar and cent point of view,— that best results were obtained from a mixture of Newcastle and Canmore slack. Mr. Pratt, in reply, stated that the element of cost entered into this feature, as, in order to attain good results, it was necessary to do the work properly, which entailed the purchase of elevating and mixing machinery. He did not believe the coal could be handled economically otherwise, and although he believed the best results were obtained by mixing different grades, he had not had at his disposal, when he experimented, a large enough supply of coal to justify him in making a conclusive record. Therefore he was not in a position to make an authoritative statement. Reverting to the subject of powdered coal, he pointed out the danger of ignition in transportation from East to West, while believing the low grade coal would ordinarily be safe, and high grade coals were well known to be safe, but he considered it would be wise to go slowly in experimenting with Edmonton and Lethbridge grades. A fire in the power house at Saskatoon had been caused by the ignition of the small coal. This coal came from middle grade.

J. G. Legrand, M.E.I.C., Winnipeg, on the suggestion being made that inasmuch as he was designing a coal mixing plant he could give some information, stated that he had found the best mixture to be mountain coal, Pennsylvania anthracite, and Pacific coal. He drew a diagram of the proposed plant, which would have a capacity of 1,500 tons per day. The mountain coal referred to was hard coal. The plant in question would be erected at Edson. D. B. Dowling stated that just about the time the war started, an exploration was made north of the Grand Trunk in the area extending from the Athabasca River to the Smoky River, and from the resulting report it was hoped that in that region would be found as large an area of coal as in all the Nova Scotian section put together.

The meeting then adjourned, to continue on Saturday morning at 9:30.

Banquet.

As guests of the Mayor and City of Saskatoon, the engineers, their wives, the Mayor and Aldermen, and a number of prominent citizens, in all about one hundred and ten, partook of a banquet at the King George Hotel, commencing at seven o'clock. While conforming to the food regulations, it was evident that there was no shortage either in quantity or quality, in Saskatoon.

After the toast to the King had been honoured, Mayor Young extended a hearty welcome to the visiting delegates. He likewise welcomed the wives present, stating that he did not know whether the engineers had brought their wives, or their wives had brought them.

Dr. Murray, in proposing the toast of the Army and Navy, spoke very feelingly of what had been accomplished by the army and navy, including the air service. It was the extreme youth of those engaged which touched him most. It was wonderful, he said, to contemplate the bravery and resource which had been exhibited by these mere boys. In mentioning the navy he drew particular attention to the work done by the trawlers in the North Sea, the silent men who went out to almost certain death.

F. H. Peters, of Calgary, who responded, said that the toast might very well be drunk in silence, for it was beyond the power of any save some great orator to deal adequately with such a subject.

The toast of The Allies was proposed by Alderman Galloway, who dwelt with tenderness upon the thought of that great army who had gone before. They had been comrades in life, he said, and he liked to think that they were comrades in the vast Beyond. W. M. Scott of Winnipeg responded, and spoke of the vast preparations of Germany. He said they lacked one important thing, a righteous cause. This, the Allies had. Some good would come out of all the horrors of the War by proving the ascendancy of the spiritual over the material.

Alderman T. A. Lynd proposed the toast of "Our Guests", stating that the only thing he knew about engineering was an old college yell beginning, "We are, we are, we are the engineers "—" you all know the rest." He admitted that he did not know the difference between an engineer and an architect, at which someone loudly invoked heavenly aid for his ignorance. He paid a tribute to the engineers saying that they were responsible

Second Professional Meeting, University of Saskatchewan, Saskatoon, August 9th, 1918.

Key to Group Photograph.

(1) W. G. Chace, (2) Geo. W. Craig, (3) J. G. Legrand, (4) A. S. Dawson, (5) F. H. Peters, (6) Dr. W. C. Murray, (7) President H.H. Vaughan, (8) Wm. Pearce, (9) Geo. D. Mackie, (10) L. A. Thornton, (11) R. F. Uniacke, (12) A. G. Dalzell, (13) Prof. A. R. Greig, (14) Geo. L. Guy, (15) W. T. Brown, (16) Mrs. J. E. Underwood, (17) Mrs. W. T. Brown, (18) Mrs. J. R. C. Macredie, (19) Mrs. L. A. Thornton, (20) Fraser S. Keith, (21) Mrs. G. D. Mackie, (22) Mrs. W. T. Thompson, (23) Mrs. Robertson, (24) Mrs. W. M. Stewart, (25) Mrs. H. McIvor Weir, (26) A. W. Lamont, (27) R. C. Gillespie, (28) J. R. C. Macredie, (29) J. McD. Patton, (30) P. R. Genders, (31) Prof. J. McGregor Smith, (32) G. R. Pratt, (33) E. C. A. Hanson, (34) M. H. Marshall, (35) H. S. Carpenter, (36) D. A R. McCannel, (37) J. N. deStein, (39) Mrs. A. R. Greig, (40) Prof. D. A. Abrams, (41) C. P. Richards, (42) Mrs. W. H. Green, (43) G. M. Williams, (44) H. A. Bergeron, (45) W. H. Greene, (46) Mrs. Lamb, (47) H. R. McKenzie, (48) J. D. Robertson, (49) H. M. Thompson, (50) B. Stuart McKenzie, (51) E. E. Brydone-Jack, (52) H. S. VanScoyoc, (53) C. M. Arnold, (54) W. J. Ireland, (55) J. E. Underwood, (56) E. Skarine, (57) C. J. Yorath, (58) M. A. Lyons, (59) L. B. Elliot, (60) E. L. Miles, (61) W. M. Scott, (62) H. McI. Weir, (63) E. G.W. Montgomery, (64) W. M. Stewart, (65) D. W. Houston.

for the opening up and developing the West, and prophesied a wonderful future in the peaceful days that were to come. G. D. Mackie of Moose Jaw responded, and thanked the City for the very cordial welcome extended to the engineers. He dwelt on the fact that this was an engineer's war. He praised very highly the engineering accomplishments of Saskatoon.

J. E. Underwood, in proposing the toast of "The Ladies" said that where women were respected most the greatest progress was made. When the toast was drunk, a verse of "For They are Jolly Good Fellows" was sung. J. N. deStein responded for the ladies in a witty speech that evoked the greatest applause. He said that since the ladies formed a very large part of the population of this Province, it was strange that they could not get someone to reply for them, but had to turn to mere man. However, since he was ex-officio a member of all committees, according to Clause 16 of the by-laws, and since there was a ladies' committee, he was now one of them. Therefore, according to Professor Euclid, of Egypt, a charter member of the engineering profession, he was a she. Q.E.D. He said that they, the ladies, thanked them for their hospitality, and thanked them for bringing them along. Man came first, and women after — and women had been after man ever since.

Mayor Young introduced President Vaughan, whom he asked to address the gathering. Mr. Vaughan complimented the Western members on their good judgment in choosing Saskatoon for their place of meeting. He had come a long way to attend the meeting, but was amply repaid many times over. He reviewed the progress that had been made within the past one hundred years, which was essentially engineering progress. The profession of enginering had also developed wonderfully in that time. There was a radical difference between the engineering profession and other careers, for instance that of law, where a lawyer knew practically everything there was to know when he came from law school, while an engineer fresh from college was just beginning to get his practical experience, which counted the most. He enlarged on the necessity for having a strong national organization, as a good Society meant good engineers. A conference such as the one just held in Saskatoon was of the greatest possible benefit to those who were fortunate enough to attend. In conclusion he thanked the Mayor and Aldermen, and the citizens of Saskatoon, for their generous hospitality, saying that he had been delighted with his visit, with the city, and with its people, and knew that all the other members of the Engineering Institute fortunate enough to attend had the same feeling.

The gathering concluded with the singing of the National Anthem, and was a social function which the engineers will long remember.

Fifth Session
9.30 a.m., Saturday, August 10th.

PROFESSIONAL AND INSTITUTE AFFAIRS.

On bringing this session to order, the President called on F. H. Peters, M.E.I.C., who read his paper:—

Legislation Concerning the Status of Engineers.

The question to be discussed is a very big one indeed, and it is not expected that the paper being submitted can cover the whole question exhaustively or completely. Rather the endeavor will be to bring out the essential points concerning this great question and deal with them in a general way. I do not want to be understood as expressing any final ideas as to how the question should be worked out in detail, but rather to place on record a little history of the movement since its start from the resolution passed by the Calgary branch last summer—much in the same way as this resolution was passed—to act as a feeler and bring out a general expression of opinion.

I would like to emphasize this point right at the beginning. If the idea of legislation is a good one, it is the biggest thing that engineers could possibly have to think about and work at, until it is either put into effect or killed. This paper is prepared for discussion by engineers and as it affects the conditions of their whole life's work, every engineer owes it to himself, his family and to the country itself to give his best thought and action towards the satisfactory settlement of this matter.

Ever since this idea was first brought up, some men have continually said, "what is the use of all this talk, we cannot do anything anyway." This is not my opinion and I firmly believe that if we can only get together and form a decided opinion as to what we want, and then direct all our efforts towards getting it, that we can surely change the conditions and cure the evils that exist by a few years of consistent work.

I will try and put the case before you by tracing this development in Calgary, and introducing some other comments suggested by outside ideas that have been expressed by writers in the various engineering publications.

The original Calgary resolution stated the opinion of that branch, that Dominion legislation should be sought to establish the status of engineers throughout the Dominion, and in order to start some effective movement, asked the Secretary of the Institute to canvas the opinion of the whole membership of the question. This resolution developed out of a general feeling of dissatisfaction and unrest among members of the profession, which existed at the time, and exists still, at least in the territory between the Great Lakes and the Rocky Mountains.

The first feeling was that the whole profession, and everything connected with it concerning the material welfare of those practicing it was most unsatisfactory. The first step was to try and analyze this feeling and see what was at the bottom of it. The result was an expression of the two definite facts, that we get neither the remuneration, nor the respect that is due to us, as members of the profession which has done more than any other to develop the natural resources and create the industries of the Dominion. The second step was to try to

determine why this was, and what we were going to do about it, and then the ball was opened and the question was discussed from time to time from every possible angle.

The engineers in Alberta—for by this time the discussion had extended to the Edmonton Branch—naturally turned to their own organization, the Engineering Institute, to look for a cure for their troubles; and here there were some very strong opinions expressed, that there was no use bothering with the Engineering Institute, —then the Canadian Society—because it had never done anything in a material way, for its members, and it was no use expecting that it would do anything in the future. If you consult the Constitution of the Institute it is very easy to see why it have never done anything for the material interest of the members, because the Institute as it exists provides only for the advancement of scientific learning, or in other words it may be classed as a purely educational body. The Institution has done this. It has fulfilled its aims and so we need not criticize it. But we want to extend its aims and efforts to include a consideration also of the material welfare of the members.

At this stage in the development, while we were not entirely clear as to why the troubles existed, and what to do, the opinion had become very firmly fixed that decided troubles did exist, and that the question which had been brought up was a real issue. And it was decided that we would do *something* and that the first thing to do was to decide on some line of action and then keep hammering away at the same place until some results were gained.

As a result of a great deal of discussion and interchange of ideas, the opinion was developed that we do not get the respect which is due us, because we are not understood and people do not know our worth. The first answer to this statement was, let us advertise, and tell the people of our worth, and give them an opportunity to understand us. The counter argument to this was, that while such a step might go a considerable length in bettering the conditions being complained of, we could never purge our ranks to uplift the profession and protect the public, unless we were able to control our organization and keep out incompetents and undesirables. It was pointed out that to-day anybody could call himself, and practice as, an engineer, and therefore advertising alone would advertise the incompetents as well as the others.

It was finally stated and accepted by the Calgary branch that legislation was the best cure for this feature. Legislation seemed to be the only possible thing that would define the name, establish some legal standard and make it possible to control the organization.

The idea of legislation is not a new one. Because some prior legislation had not worked out as a practical success there were still some doubts expressed as to its practicability. The idea, however, as stated above, was generally accepted. But a considerable number of members who were very sincere in their desire for a betterment of conditions, and were frank enough to state their opinions, asked the question, "will this increase our remuneration, because that is the sum and substance of what we want?" The answer to this question was, that nothing could do this specifically and directly except a trade union, and that any idea of forming a trade union was rejected without argument. But it was endeavored to get these members to take a reasonable view of the matter and it was pointed out that if we could get a law to define our status and bring us together so that we could speak with one voice, then if we were active, reasonable in our demands and consistent in our efforts, it seemed that we should certainly be able to gain the recognition and remuneration that was desired.

It was pointed out in discussing this feature that our profession was working under peculiar conditions, in that the members were nearly all employed by the Governments, the large corporations, or other big enterprises. In this respect our profession is very different from the doctors and lawyers, who are for the most part carrying on private practice. It is admitted that this is a very difficult feature and it is hard to say just what effect it will have on making legislation a practical success in bringing about the results desired, but if nothing in the affirmative can be guaranteed it can at least be stated with assurance that legislation cannot possibly do any harm, because conditions could not be worse in connection with the points being discussed, that they are at present.

Then some other members said, admitting all your statements, and although you veil it very nicely, what you are really seeking by the proposed legislation is a close corporation, and they said the close corporation idea has many bad features, as it has been worked out with other professional men, notably the doctors and lawyers. The answer was, perhaps so, but perhaps this has been the cause, because their corporations are too close. And again we have a great advantage starting in at this time, because we know of these faults that have tended to develop with other professions, and we can profit by them and guard against them in our own case.

Then again some said it is unprofessional and undignified to seek legal protection and it is not done by the American Society of Civil Engineers, or by the British Institute. As to this first contention it was considered a quaint conceit that these same men were largely the same ones who had wanted to advertise. As to the second contention, a search for precedent is always a wise course, and a safe course, but if one goes too far in looking for precedent it becomes the greatest millstone around the neck of advancement, and it was suggested that we really have precedent in the Manitoba and Quebec Acts dealing with Engineers; in the Alberta and Saskatchewan Land-Surveyers Acts, and also the passing of an Act covering the profession of architects and engineers in the State of Illinois.

So taking it bye and large, the matter has been pretty well threshed out at Calgary, and we have decided on legislation as the only logical and legitimate means of gaining a permanent cure. Really it seems that legislation is the *only* way to achieve anything of permanence, because if you follow the matter out to the end, you might argue and talk and advertise, or fight if you will; but in the end if you have not the law of the land to back you up, to use a slang expression, "Where do you get off at."

It was considered most desirable to go straight for Dominion legislation so that there would be one law in effect from coast to coast, and in this way all the possible difficulties on account of variation in Provincial laws would be done away with. Sketching the desired legislation in a very broad way, it was, to fix a standard by defining the term engineer. To provide adequate and practical means of control of the profession by requiring compulsory registration as a necessary antecedent to practice. To provide adequate penalties for infraction of the law, and finally in order to avoid the criticisms which might be directed against, and the faults which might come from, a close corporation, to have stipulated by the legislation a certain measure of outside control. This last point is really the only idea that contains anything very new and different from the legislation which is already in force in some other places. It was the idea at Calgary that the most desirable method of gaining some outside control was to arrange this through the recognized Universities. The universities in the Dominion are maintained at public expense, or by private subscription for the purpose of educating young men and fitting them to follow the practice of engineering, and it seemed most consistent that after these authorities had trained the young men in the profession, that they should later on have some voice in controlling them during the period that they were practicing the profession.

The next advancement in the matter came through a meeting of the Ottawa branch which was held during the winter of 1917, when the writer of this paper explained the development of the movement up to that date. The resolutions which were passed by this meeting gave a very decided impetus to the advancement of the matter, because it was the first definite expression of opinion from any Eastern branch, and the opinion of this meeting was very definitely expressed as being favorable to the idea of legislation. Another very important point which was discussed at this meeting, was the practicability of gaining legislation and as the result of considerable discussion it was pretty definitely understood that it would not be possible to gain Dominion legislation. Following this the idea was expressed that the next best way of going about the gaining of legislation was to get as nearly as possible, standard Acts passed in the various provinces, and then finally gain Dominion legislation, bringing them together in a similar way to the Dominion Act passed recently covering the medical profession.

Another step in advance was made in the Spring of 1918 when this matter was very fully discussed at a meeting in Edmonton, of the Alberta Division. This meeting finally welded the Calgary and Edmonton branches together as being strongly in favor of legislation, and we were further very fortunate in having with us the Secretary of the Vancouver branch, who was able to state that in his opinion there was no question but that the engineers in British Columbia would, after the matter was lined up a little more, certainly approve of the idea of provincial legislation.

With a view to gaining some action in the near future, it is proposed at the Saskatoon meeting of the Institute to present proposed provincial acts by the provinces of Manitoba and Alberta. In both of these provinces, as also in British Columbia and Saskatchewan, we have great facility for introducing the proposed measure of outside control through the Universities, because in the several provinces noted, there is one provincial University, so that there are no difficult questions introduced by having several recognized Universities to deal with, with the possibility of friction between them, as might be the case, for instance, in Ontario.

During the last few months there have been a good deal of talk and writing in the Engineering publications along the lines of this paper, and it would appear that in general, everybody has this matter in mind. This is a most excellent sign and may be taken almost as a practical assurance that the time has come when something is going to be done. The ideas which have been expressed are generally all along the same line, with the exception of some Engineers who still advocate that a close corporation, and nothing but a close corporation will meet our requirements. Unfortunately, it seems necessary to note some exceptions amongst the engineers who have been writing on this matter, and who have suggested ways and means of gaining our ends, that certainly would not be approved by the people of the Dominion of Canada. For example, one writer in the Canadian Engineer, suggested that the engineers advertise the fact amongst the young men at the Universities that the profession of engineering is the worst one they could possibly go in for, and by this means discourage engineering undergraduates; cut off the supply of young men which would in turn create a scarcity of engineer and obviously leave room for an unnatural boosting of salaries. It is necessary to point out most strongly that any suggestions along these lines are very bad, and should be frowned on by all members of the profession. We must play this game straight with all our cards on the table, and avoid all these foolish and unreasonable ideas, always remembering the basic idea, which is to uplift the profession and place it in a better position to serve. If we once lose sight of this basic idea we must lose public confidence and the whole movement would undoubtedly be wrecked before anything very concrete had been achieved.

There is one special point which has come up in connection with this matter which is worthy of the greatest consideration and attention by the members of the Institute. That is the matter of some difficulties and friction which has already arisen between the Engineering Institute and the Mining Institute. It is quite apparent to anybody who looks into the case that there are some old sores of long standing between the Civil and Mining Engineers. The writer of this paper is one of the younger men of the profession, who was not in the game when these old sores were opened up, and undoubtedly a very large number of the civil and mining engineers of to-day are the younger men who do not have any of the old feelings of jealousy or resentment which no doubt used to exist. It is particularly unfortunate that any feeling of this kind should exist, and certainly there seems no reasons why any friction or difference should continue to exist between the civil and mining engineers. It is most sincerely hoped starting with the head office organization in Montreal that every civil engineer in Canada, will be prepared to go more than half way in meeting the mining

men in any difference of opinion, or old bad feelings which might exist. It would seem that if a movement of the kind being discussed, is going to start off by first having a row with the members of a closely allied profession, it would augur very ill for the future.

It is rather difficult to prepare a paper of this kind, because it is not so much a question of expressing ones own ideas, as to try and express truly the ideas that have been brought out and agreed to by the membership of the Institute at large, in so far as they have expressed any opinion. The paper has been prepared with a view to putting on record a brief history of the movement up to date, with a view to bringing out the main ideas under discussion, and an expression of further views from all the representatives who are in attendance at the Saskatoon meeting. Up to date the stepping stones in the progress of this movement have been the various meetings held at various places in the West and at Ottawa, and it seems that this meeting, which is larger and more representative than any of the others referred to, should place the movement well over the top of the stile. We have a particularly good opportunity to bring all our ideas together and get expressions of opinion from the most representative engineers throughout the country. I refer particularly to our President and Secretary from Montreal and all the other older members of the profession who are in attendance.

C. P. Richards, A.M.E.I.C., stated that the gratitude of the engineering profession was due Mr. Peters for his activity along this line, for he has placed a match to the gunpowder, and what he has described as a feeler might properly be described as a fuse. At a meeting of the Saskatchewan Branch a committee had been appointed to prepare a draft of the proposed Act in Saskatchewan concerning engineers. They had had very little time to work on this matter, but it was evident from the draft which he submitted that it had been the subject of considerable thought. The various clauses were read and discussed, and since even the committee did not consider the draft complete, it was *resolved that this draft be reported back to the Legislation Committee at the Saskatchewan Branch to be re-drafted and that copies be sent to the legislation committees of the four Western Branches and Council as soon as the draft was completed, and not later than the first of September*, the intention being to draw up an Act that would be suitable for all provinces.

It was clearly evident, from the opinions expressed at this meeting, that the members present believed that some form of legislation was necessary to give recognition to the engineering profession, and to protect the public against the wilful expenditure of public money by allowing incompetent men to supervise municipal and other public work. In taking part in the discussion, the President, James White and William Pearce, all emphasized one point, which was, that no legislation should be sought which did not recognize the rights of competent engineers who were not members of the Institute, mentioning particularly those in the Mining Institute.

It was shown that there would be a full and complete discussion on this subject which has been given so much attention recently, and when the Chairman announced the meeting open for discussion, such proved to be the case. With a single exception, there was apparent an enthusiastic feeling in favor of immediate steps being taken. At the same time it was considered that nothing should be done hastily, and that any legislation sought should be as nearly uniform as possible in the different provinces. As the President was leaving for Winnipeg at twelve o'clock, it was necessary for him to leave before the meeting was over, and before saying goodbye to the meeting, said that no engineering meeting he had ever attended had given him greater pleasure or profit. He stated that he wished to remove an apparent misapprehension, which existed in the minds of many of the Western men, which was that the Council was opposed to legislation, for such is not the case. While there are certain members, and prominent ones, who do not feel that there is much to be gained by legislation, yet, this is a matter that has concerned Council most seriously for some time, and it was a question of reaching a conclusion as to what was the best thing to be done. He personally felt that legislation of a suitable kind would be most desirable. By the presentation of the paper from the Saskatchewan Branch, something more denfiite had been reached, and which was, up to the present lacking, namely a draft of what was really required or desired in the way of an Act, as it is a difficult matter to determine what we want in the way of legislation. We must not become a trade union, and use our organization as though it were such. Care should be taken in drafting the Act that it should be such as to contain not only what we want but what will be recognized that we are entitled to. The keynote of the draft seemed to be that it compelled the employment of engineers in responsible charge where public monies were to be expended for public works to the extent of over $500.00. Everyone will recognize the justice of this.

The closely united organizations possessed by the lawyers and doctors, wherein they receive special privileges, are justified on one basis only, and that is the protection of the public. When a man has legal business to transact, he requires a lawyer, and he wants to know that he is qualified. When one is sick, and in need of a doctor, it is necessary that he knows that the man who is attending him measures up to a standard in which he may have reasonable confidence. The same thing applies to the engineering profession, although it has never been recognized by the public how much they must rely on, and how much they are indebted to, engineering skill for their personal safety. The question of public safety and the administration of funds on public works are two good points to build from. "Personally, I have come to the conclusion," said Mr. Vaughan, "that the man in responsible charge of engineering work should be a qualified engineer under this Act." He cited the difficulties which the Quebec Act had occasioned, and therefore it was necessary to proceed with the greatest possible caution. Before final conclusions were reached, a complete discussion should be carried on in the *Journal*, which is the medium through which all matters relating to our profession should be given expression. Now that the *Journal* had been established, it was to be hoped that the members would take advantage of the opportunities it afforded, and make use of it in every way, and parti-

cularly when a matter such as this was being discussed. All members of our Institute will thus get the benefit of the discussion, which should be carried on in that way. (Prolonged applause). He suggested that Mr. Richards write an article for the *Journal* covering the substance of the proposals, leaving out the legal phraseology. This would, as it were, inaugurate the discussion which could then be made as complete as desired. While concurrent legislation in all provinces would be ideal, it is hardly possible. However, the example of one province is likely to have an effect on other provinces, and consequently, when secured in all provinces, it would be a simple matter to have it linked up by Federal enactment. The Act drawn up by the Saskatchewan Committee was worthy of hearty commendation, the establishment of an Engineering Institute of Saskatchewan being ideal. Consideration should be given to having a requirement of a longer period than two years' professional responsibility, and the Act should provide for electrical, mechanical and other engineers, as well as civil. The proposed University Board, to pass on a man's qualifications, should consider a man's practical experience as well as his theoretical knowledge. This discussion is just what was needed, getting down to a concrete basis along the line of proposed legislation, whereby we have something definite to discuss. C. J. Yorath, Saskatoon, was glad that the question of legislation had come up, as it was necessary that a measure of protection be afforded. The only way that the expenditure of public money can be properly controlled is to have the men responsible for this expenditure required to possess a standing, necessary under legal enactment.

A lengthy discussion followed in which L. A. Thornton, G. D. Mackie, M. H. Marshall, B. S. McKenzie, G. W. Craig, C. P. Richards, the Secretary, L. B. Elliot, F. H. Peters, J. N. deStein, William Pearce, W. M. Stewart, James White, J. E. Underwood and A. G. Dalzell participated, after which the resolution mentioned above was unanimously carried.

The western men have worked up a greater amount of enthusiasm than exists in the East, and are to be complimented for taking the lead in this important matter.

Conclusions.

The feelings of the members present were suitably expressed in a number of resolutions:—

It was resolved that this meeting agree that a similar professional meeting be held every year under the joint auspices of the branches of the four Western Provinces, and and that the place at which Council would be asked to endorse the professional meeting for 1919 would be agreed upon later by the Executives of the branches.

It was resolved that the meeting express, through the Secretary of the Institute, its heartiest thanks to Dr. W. C. Murray, and members of his staff, in allowing the meetings to be held in the University, under such ideal conditions, and for providing sleeping and dining quarters for the visiting members.

It was resolved that in appreciation of the hospitality and courtesies extended by the Mayor and many citizens of Saskatoon, that a letter expressing the cordial thanks of the meeting be sent by the Secretary to the Mayor, and through him to the citizens of Saskatoon, for their kindness.

In appreciation of the splendid work which he had done in connection with the ideal arrangement made for the meetings, J. N. deStein, Secretary-Treasurer Saskatchewan Branch, who was present, was accorded a hearty vote of thanks.

Before concluding, the Secretary was requested to draft a letter to be sent to the men overseas, extending greetings and best wishes for their welfare. The Secretary suggested that the meeting endorse a tobacco fund again this year to provide for remembering our men overseas, and the suggestion was endorsed with applause.

A vote of thanks was passed to the Press of the City of Saskatoon in giving so much space and attention to the meetings.

In conclusion, the members from Saskatchewan recorded their thanks to the eminent engineers who had travelled such great distances, and made it, what it was, the most successful engineering convention ever held in Canada.

At the dinner held in the University dining hall after the adjournment of the formal session, the Secretary gave a brief address on the progress of the Institute during the past twelve months.

In the afternoon visits were made by means of automobiles, generously provided by the citizens of Saskatoon, to the various points of engineering interest in the city, including the power plant, pumping plant, including filtration system, the cold storage plant, and a modern grain elevator.

During the afternoon and evening the members took their departure to their homes East, West and South; without exception, pleased and thankful because of their good fortune in having had the privilege of attending, what every one present believes to be, the most sociable and instructive conference that the engineers in this country have yet enjoyed.

Register.

Those who signed the register of attendance at the Second Professional Meeting were:

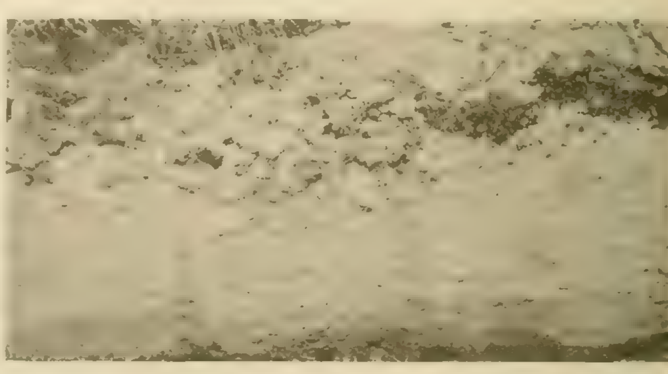
J. G. Legrand, bridge engineer, G.T.P.Rly., Winnipeg; M. A. Lyons, chief engineer, Good Roads Board, Winnipeg; Geo. L. Guy, engineer, Utility Commission, Winnipeg; H. M. Thompson, chemist, Greater Winnipeg Water District, Winnipeg; W. M. Scott, consulting engineer, Winnipeg; A. R. Greig, professor of Engineering, University of Saskatchewan; E. Brydone-Jack, district engineer, Department of Public Works, Winnipeg; A. W. Lamont, Canadian Westinghouse Co., Winnipeg;

W. M. Stewart, consulting engineer, Saskatoon; D. W. Houston, superintendent Regina Municipal Railway.; L. A. Thornton, city commissioner, Regina; E. G. W. Montgomery, assistant engineer Highway Dept., Regina; L. B. Elliot, dist. engineer, Department of Public Works, Edmonton; A. G. Dalzell, municipal engineer, Vancouver; J. N. deStein, consulting engineer, Regina; C. M. Arnold, Dept. of Irrigation, Calgary; F. H. Peters, chief engineer, Dept. of Irrigation, Calgary; M. H. Marshall, office engineer, Dept. of Irrigation, Calgary; R. C. Gillespie, assistant city engineer, Calgary; Geo. W. Craig, city engineer, Calgary; R. W. E. Loucks, engineer, Land Title Office, Regina; H. S. Carpenter, deputy minister of Highways, Regina; E. L. Miles, inspecting engineer, Dept. of Irrigation, Calgary; E. C. A. Hanson, consulting engineer, Winnipeg; H. R. MacKenzie, chief field engineer, Dept. of Highways, Regina; R. D. McLaurin, Univeristy of Saskatchewan; P. R. Genders, engineer Land Titles Office, Regina; C. P. Richards, bridge engineer, Highway Dept., Regina; J. D. Robertson, engineer of Highways, Edmonton; Wm. Pearce, Dept. of Natural Resources, C.P.Ry., Calgary; R. F. Uniacke, Supt. Penitentiaries, Ottawa; James White, deputy head, Commission of Conservation, Ottawa; H. S. Van Scoyoc, publicity engineer, Canada Cement Co., Montreal; G. R. Pratt, fuel engineer, C.P.R., Winnipeg; A. S. Dawson, chief engineer, Dept. of Natural Resources, Calgary; Fraser S. Keith, secretary, The Engineering Institute of Canada, Montreal; Geo. D. Mackie, city commissioner, Moose Jaw; W. H. Greene, assistant city engineer, Moose Jaw; H. McI. Weir, assistant city engineer, Saskatoon; D. B. Dowling, president, Can. Mining Institute, Ottawa; President H. H. Vaughan, general manager, Dominion Bridge Co., Montreal; C. J. Yorath, city commissioner, Saskatoon; J. E. Underwood, consulting engineer, Saskatoon; A. H. Dion, manager, Street Rly., Moose Jaw; J. R. C. Macredie, division engr., C.P.R., Moose Jaw; T. W. Brown, consulting engineer, Saskatoon; W. G. Chace, chief engineer, Greater Winnipeg Water District, Winnipeg; B. Stuart McKenzie, consulting engineer, Winnipeg, Man.; G. M. Williams, U. S. Bureau of Standards, Washington, D.C.; D. A. Abrams, professor Lewis Institute, Chicago; J. MacGregor Smith, prof., Univ. of Saskatchewan; D. A. R. McCannel, city engineer, Regina; Emil Skarine, contractor, Edmonton; W. J. Ireland, assistant engineer, Dominion Hydrographic Dept., Winnipeg; J. McD. Patton, bridge engineer, Dept. of Highways, Regina; Guy C. Dunn, division engr., G.T.P.Ry., Winnipeg; F. E. Betts, Saskatoon, Sask.; F. W. Bates, Saskatoon, Sask.; Richard Weir, Saskatoon, Sask.; Gerald Graham, Saskatoon, Sask.; Arthur Wilson, Saskatoon, Wask; A. E. Etter, Saskatoon, Sask.; Norman L. Thompson, Saskatoon, Sask.; H. A. Bergeron, Winnipeg, Man.; R. P. Johnston, Saskatoon, Sask.; W. McMaster, Saskatoon, Sask.; Prof. J. L. Hogg, University of Saskatchewan, Saskatoon, Sask.; M. McKenzie, res. engr., C.P.Rly., Regina, Sask.; C. M. Hackett, Saskatoon, Sask.; R. Blackwool, Saskatoon, Sask.; E. J. Stone, Winnipeg, Man.; O. W. Smith, Regina, Sask.; R. C. Robinson, Saskatoon, Sask.; W. J. Thompson, Saskatoon, Sask.; S. G. Dawson, Calgary, Alta.; A. A. Murphy, consulting engineer, Saskatoon, Sask.

Deterioration of Concrete

Concrete Deterioration, Alberta. No. 1. Spillway Wall.

Concrete Deterioration, Alberta. No. 2. Spillway Wall.



Concrete Deterioration, Alberta. No. 3. Spillway Wall.

Notes on Saskatoon Meeting.

(Contributed)

President Vaughan was in his usual golf form and carried away the scalps of the Saskatoon experts, including Mayor Young and City Commissioner Yorath.

It would have been a proud moment for Professor Euclid of Egypt had he been present at the banquet when the " she " proposition was demonstrated.

A timely suggestion from D. W. Houston of Regina that the Concrete Committee examine the south end of the swimming pool at the University for signs of concrete deterioration.

Professor Greig's straw consuming automobile — now that it has received the approval of the Engineering fraternity will soon be " doing its bit " in solving the fuel and transportation problems of the Prairies.

There is an iron cross waiting for the man who wired the wife of one of the visiting members so that the next morning she also was a delegate to the Convention.

Rumors of several stag parties being held after the regular sessions have not yet been confirmed. It is quite evident that no arrests were made and that we are again at liberty to return to Saskatoon as the following letter from Mayor Young will testify:

Dear Sir:—

"I acknowledge receipt of your letter of the 12th instant thanking us for attention given during your stay here. Let me say that we were very pleased to have your Institute meet in our City and any little trouble which we had was a great pleasure.

I hope that in future you will again consider our City as a meeting point, and please consider that all times your Convention will be very welcome here."

Yours very truly,

A. MacG. YOUNG.

Manitoba Notes.

Fourteen representatives from the Manitoba Branch of the Institute attended the recent General Professional Meeting at Saskatoon, August 8, 9 and 10th. They were accompanied by Prof. D. A. Abrams of the Lewis Institute of Chicago, representing the Portland Cement Association of America, and Mr. G. N. Williams of Washington, D.C., representing the Bureau of Standards of the United States Government.

Those attending the convention thoroughly enjoyed the programme which had been prepared. The papers received general discussion, and the members of the Branch were quite satisfied with the fact that in connection with the more important subjects committees were appointed with specified powers to carry on study and research. It was noted that the appointment of a committee to prepare specifications and plans for a standard earth road received also certain commendation from the public press.

The most important subject studied at the convention was considered to be the question of the durability of concrete structures in alkali soils such as are built throughout the Prairie Provinces. It was to gain information on this subject that the experts from Chicago and Washington attended the meetings and Professor Abrams' able paper on the principles of concrete manufacture was heartily welcomed and appreciated, and the thanks of the Institute are due to Professor Abrams and to his sponsors for this courteous contribution. It is hoped that when that gentleman's studies shall have been carried sufficiently far for his own satisfaction he will contribute to the engineering fraternity a complete and exhaustive report of his work.

The convention in recommending to the Council of the Institute that a standing committee of the Institute be appointed took a step in the proper direction, looking to the gaining of the support of the Institute as a whole to the scientific study of this most serious problem for the Western Canadian communities and investors, and at the same time will add to the prestige of the Western Branches who have taken the initiative in this matter. The papers presented to the convention indicated clearly the seriousness of the problem and its magnitude, and in their suggestions outlined a proper direction for the work of the standing committee. It is to be hoped that a strong support will be given to this committee, not only by the Institute but also by the Dominion, by the Western Provincial Governments and by the Western municipalities, all of whom have large investments in various concrete structures, and all of whom must in future depend upon concrete as a class of construction for the numerous utilities required in the development of this country.

On their return from Saskatoon Messrs. Abrams and Williams were shown structures whose concrete body is rapidly decaying. They also inspected with considerable satisfaction the various classes of concrete work now being built by the Greater Winnipeg Water District.

Manitoba Branch.

The first meeting of the Manitoba Branch for the fall session will be held on September 19th. At this meeting reports will be presented to the Branch on the papers read and discussed at the Saskatoon Professional Meeting. W. G. Chace, M.E.I.C., will report on the Durability of Concrete in Alkaline Soils, followed by a report by M. A. Lyons, M.E.I.C., on the Good Roads problem. On behalf of the Legislation Committee of the Branch, H. M. Scott, M.E.I.C., will submit a report on By-Laws for the local Branch.

The Provencher Avenue Bridge, across the Red River, connecting Winnipeg and St. Boniface, and replacing the Broadway Bridge is now open for traffic, although the approaches are not complete. The bridge is of the Scherzer twin-leaf, Bascule type. It is wide enough to accommodate twin car tracks with ample room on either side for vehicular traffic and side-walks.

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The Second Professional Meeting.

Any adequate impression of the second professional meeting of The Engineering Institute can be given only by the extreme use of superlatives. Those present were unanimous in saying that it was the greatest engineering convention ever held in Canada, because it was the most enthusiastic, was permeated by the warmest fraternity, was conducted on the highest plane of technical discussion, was a supreme evidence that engineers are public spirited, and was an unusual contribution to the national engineering literature. Further, it inspired and inaugurated not only one but several movements that will bear direct advantageous results in the interests of the profession in Canada.

Those fortunate enough to be present came away inspired with a greater zeal for their own personal endeavors, benefitted by the intimate association with their fellows and by the information gained and resolved that inasmuch as they were part of a great organization they would do their share to further its welfare. It was a gathering which to use the words of President Vaughan, "following the success of the Toronto meeting, firmly established professional meetings in a position of premier importance in the affairs of the Engineering Institute."

It was thought by some that five sessions would be an ordeal but such was not the case. During the entire programme the interest never flagged and the discussion was as keen at the final session as at the first. Western progressiveness led the way; Western hospitality prevailed and the Western spirit of foregoing precedent was in evidence. To the man in the West who arranged the programme, contributed the papers and added so much to the discussion, the profession owes a debt of gratitude.

Good Roads.

The papers presented on this subject and the discussion following showed that it has been receiving no small attention from the engineers and Governments of the Prairie Provinces. Legislation either designed or under way will tend to give proper supervision to road construction and provide a suitable policy for financing and maintaining rural highways. It was shown that inasmuch as at least 90% of the prairie highways must remain as earth roads indefinitely, their location, construction and maintainance are of vast importance. The most essential features in the construction of earth roads are proper location and adequate provision for drainage. In the location of a road the following factors require consideration:—maximum permissible grade, directness of route, cost of construction, safety for traffic, soil formation and the amount of traffic. Provision for drainage must include the rapid shedding of water from the road surface to side ditches, and from side ditches to natural drainage channels as quickly as possible.

Permanent through highways should not be left to the individual municipalities through which they pass, but should be part of a provincial policy and should be provincially owned and constructed.

Under present conditions many of the road difficulties will be overcome under competent engineering supervision of construction and constant well directed maintenance.

Inasmuch as there is no standard specification for an earth road a resolution was unanimously passed as follows:—

> *THAT a Committee consisting of H. S. Carpenter, representating Saskatchewan, M. A. Lyons, representing Manitoba, and J. D. Robertson, representing Alberta, be appointed to draw up a standard road specification including a road policy and report back to the next Western professional meeting.*

Water Supply and Sanitation.

The question of water supply and sanitation is a great problem in the prairie provinces due to the fact that many places lack natural drainage and in large sections water supplies are not only not abundant but their scarcity is a definite hindrance to settlement and development. Even the supply of water for rural communities becomes an engineering question necessitating educating farmers to the fact that the initial expense of providing a suitable water supply becomes a good investment. Referring to Saskatchewan, particularly the southern portions and southern Alberta, it was shown that some large comprehensive water supply scheme should be adopted but before its adoption should receive a thorough study by a board of competent engineers appointed for that purpose. This was a question which affected not only the provinces themselves but the whole Dominion and the railways. A suggestion was made that a board be established to make a comprehensive report on a general water supply for Saskatchewan. British Columbia and the provinces from Ontario eastward with their abundant supplies of water do not realize how greatly the question of suitable water supply concerns the prairie provinces.

Concrete.

The papers on the deterioration of concrete and on the subject of concrete and cement generally, together with the illuminating discússion thereon, would alone have been sufficient justification for this meeting as it has added considerably to our knowledge of concrete and has placed the engineering profession in possession of facts which it is well that engineers should know. That this question has been absorbing the attention of some of the best engineering minds in the West, is shown by the fact that committees of the Calgary branch and of the Manitoba branch have been studying the subject of the deterioration of concrete for some time and have supplied us with valuable information. The Manitoba committee was particularly handicapped by being unable to obtain a history of the structures which have failed. However, they deduced results of importance. The Calgary committee finds the usual causes of the disintegration of concrete to be: 1. Bad workmanship. 2. Poor and unsuitable materials and badly graded and proportioned mixtures, including amount of water used. 3. Alternate wetting and drying out, and alternate freezing and thawing out. 4. Destruction and removal of the protecting outer skin from various causes. 5. The presence of an excess of alkali salts. In its investigations of concrete where the workmanship was good and all done under close supervision, the aggregates were mostly bank run gravel and river gravel, the water from rivers and local wells, the cement used having passed standard tests. The worst conditions were found on types of structures whose design had necessitated their being back filled on one side and subjected to heads of ground water from the same direction and at or below the original ground surface. These conditions seemed to be aggravated where structures are subject to dry and wet surroundings, exposed to sun and shade in the winter months, excessive velocity, where alkali salts are most in evidence and the ground wet. The fact that the deterioration starts on the surface extending inwards and that the water being carried by the structure has analytically been shown not to be responsible for the trouble, would indicate that the deterioration was primarily due to the ground water and its effect on the concrete. This committee has based its report on the direct responsibility of its members for the construction of over 250,000 cubic yards of concrete. The verdict has been pronounced that the disintegration is caused by alkali salts and that the sulphates are the most active. Further observations of this committee are under way, the results of which will be received with interest. The conclusion has been reached that we must get away from the idea that any foreman can handle concrete the way it must be handled. Specifications should demand better workmanship, better materials where possible, richer mixtures with less water, providing the best possible drainage facilities, using water gas tar and coal gas tar on the surface of walls, subjected to conditions which are known to cause trouble and closer supervision by men who know the concrete business as a specialty.

It was realized that this question was one which should be more thoroughly investigated and consequently it was resolved

THAT Council be requested to appoint a Committee to be known as "The Research Committee on the Action of Alkaline Salts on Concrete" to carry out such experiments and investigations as they consider desirable, with power to collect funds in the name of the committee to enable them to carry out their work.

Fuel.

As the papers read covered this subject very thoroughly, and due to a reduction in the time alloted for this session, there was a limited discussion. It is evident that the fuel situation in the prairie provinces may be placed on a satisfactory basis by the utilization of several means. Already the briquetting of lignite has received due attention with the result that a Board has been appointed by the Dominion Government to commence at once to provide fuel. The Chairman of the Committee, R. A. Ross, M.E.I.C., has studied the subject thoroughly and the results are bound to have a salutary effect on the fuel situation. The use of pulverized fuel which has as yet been very slightly adopted but offers possibilities which could at least have a beneficial effect. A properly designed furnace to burn the lignites as received from the mine is a further immediate prospect. It is probable that a combination of the different possibilities and their adoption will eventually solve the problem.

Professional and Institute Affairs.

Important as were the four preceding sessions, the final one will have a far-reaching effect on the affairs of the profession in Canada. Members of the Institute from the Atlantic to the Pacific will read with interest that at this meeting a movement was inaugurated with the expectation expressed by those present that it would lead to early action in providing legislation whereby the public would be protected against incompetent engineering service and the profession given a legal status it did not now enjoy. The proposed draft of an Act for Saskatchewan which was designed to serve as the basis of a model for all provinces, was referred back to the legislation committee of that branch to be forwarded later to Council and to the legislation committees of the other Western branches, and later to all branches. It was clearly shown as far as the meeting was concerned that it was desirable to secure provincial legislation in every province and in doing so, such legislation should be eminently fair to all engineers, whether members of the Institute or not. The question is one which has received a great deal of thought for many years and has been the source of considerable argument where directly opposing views have been expressed. During the past year, however, there seems to have been a growing conviction realized by a majority of the members of the profession that something should be done. This is a matter that should receive the fullest possible discussion and the members of the Institute are requested to give an expression of their views through the medium of the *Journal*.

* * *

The Quebec Bridge Official Test.

Speaking of the wonderful achievement in the erection of the Quebec bridge, a prominent newspaper man of Montreal remarked within the past month that it was most unfortunate that the Quebec bridge had not received a fraction of the publicity which its importance warranted. Completed at a time when the mightiest events in the world's history were holding its people in tragic attention, the spectacular features of this engineering marvel received scant attention.

Recently the Dominion Government subjected this structure to a test more severe than any which it will be called upon to withstand at any time. Those who were responsible for the design and construction of this bridge entertained slight fears regarding the result. However, it is a source of gratification to know that in

withstanding the final official test there is forever removed any doubt as to the justification of the design adopted. To the many men in the engineering profession whose minds for months and years were employed in connection with this structure, the *Journal* extends heartiest congratulations. The bridge itself is engineering history and the names of the men whose genius made it possible, will live in the engineering annals of the country for all time.

St. Lawrence River Water Power.

The New York and Ontario Power Company, a corporation organized under the laws of the State of New York, has made application to the International Joint Commission for approval of its plans for the reconstruction, repair and improvement of its dam, hydraulic structures and water power property, at Waddington, N.Y. on the St. Lawrence.

Statements in opposition to the application have been filed by the Dominion Government, the Dominion Marine Association, Montreal Harbour Commission, and the State of New York.

The Dominion Government is opposed to the prayer of the applicants being granted but through the Solicitor General, the Hon. Hugh Guthrie, has signified its willingness to enter into immediate and intimate negotiations with the Government of the United States, not only with a view to solving the present requirements of the applicant company, *but with a view to working out a comprehensive project which will realize the maximum possible advantageous use of the St. Lawrence River for the development of power at Long Sault Rapids, such project to be carried to completion by the Governments of both countries jointly.*

The first hearing of the application was held at Atlantic City, Aug. 12th-13th, in which all the interests affected were represented. After hearing counsel on both sides the Commission decided in order to best meet the views of all parties, to postpone the conclusion of the hearing, to Montreal on Aug. 29th. While the Journal is going to press the adjourned meeting of the International Joint Commission is in session at the Court House Montreal, with an array of prominent engineering and legal representatives of all the governments, commissions and corporations interested in attendance. A more complete statement of the matter—one of utmost importance to both countries—will be available for the next issue of the Journal.

Crusading Pays.

The announcement was made late in August of the appointment by the Dominion Government of a Lignite Utilization Board, to be charged with the responsibility of solving the problems concerning the development and use of lignite coal deposits in central Saskatchewan. The Board will consist of R. A. Ross, M.E.I.C., of Montreal, Chairman; J. M. Leamy, A.M.E.I.C., of Winnipeg, provincial electrician; and J. A. Sheppard, of Moose Jaw, Saskatchewan. Mr. Ross will represent the Dominion Government, Mr. Leamy the Government of the Province of Manitoba, and Mr. Sheppard, the Saskatchewan Government.

For several years the engineers of the Fuel Testing Division of the Department of Mines, under the direction of B. F. Haanel, M.E.I.C., have been securing all the necessary data to work out a satisfactory solution for the use of the lignite coals, especially those of the central prairies. W. J. Dick, M.E.I.C., while consulting mining engineer of the Commission of Conservation, also worked out certain general features of the problem. These engineers have crusaded for years in an effort to secure constructive action in the development and utilization of the lignite coals of Western Canada, but it rested with the Honorary Advisory Council for Scientific and Industrial Research to focus the attention of the authorities upon the absolute necessity for immediate action, if the acute fuel shortage of past winters is going to be even in a small measure, relieved in the winters to come.

As Chairman of a special Lignite committee of the Research Council, R. A. Ross, M.E.I.C., has given freely and without stint of his time to the lignite problem of Western Canada. We hear a great deal of the "dollar a year men" experts in the engineering, financial and business life of the neighboring republic, who are at Washington, devoting their time to assist in working out problems arising from the complete dislocation and speeding up of industrial effort in the United States, to meet the exacting demands of war conditions. But little is heard of the services being rendered the State by many of our leading Canadian technical men. The members of the Research Council, who have given so much of their time to the Government in solving many important problems vital alike to war and peace times, will be compensated in some small measure, by the realization that in this one particular, at any rate, definite results have been obtained.

While it is regretted that the Lignite Utilization Board was not formed in time to get the work well under way during the summer season of 1918, it is very gratifying to know that all the crusading in past years of the permanent Government engineers has, as a result of the Research Council's efforts, culminated in definite though delayed action.

Should Engineers be "On Tap" or "On Top"?

The Ontario Government has recently announced a broad policy for aiding municipalities in meeting the deficiency of houses to shelter increasing industrial population. Two million dollars has been assigned for this purpose, to be loaned to municipalities on the recommendation of a Board, composed of Sir John Willison, Frank Beer, and Professor Sissons, all of Toronto.

Presumably for self inspiration or education, it is understood that this Board intends calling for a competitive essay on "Housing", for which a generous prize will be given. There has not so far been announced the inclusion of any technical men, either engineers or architects, on the Board.

In such an important matter as housing, dealing as it does with the vital problems of construction, it is difficult to understand the absence of an engineer from the Board. This is simply another outstanding case of lack of appreciation on the part of our political powers for the engineering profession, and is an evidence of the intenable view of one of our Federal Ministers, that technical men should be "on tap" but not "on top".

Anyone familiar with the progress of the allied cause in this present war conflagration recognizes that it is an engineers' contest. The great commanders are nearly all engineers. During the early stages of the war when they were merely "on tap", muddling throve—now that they are "on top", things are beginning to right themselves —a glorious vindication of the technical handling of a technical problem.

A Town-Planning Course Needed.

The town-planning movement in Canada so ably fostered by the Commission of Conservation has resulted in the passing of legislation in nearly every Province, providing for proper town-planning. At the present time it is doubtful whether these Acts can be properly enforced. Certainly it will be exceedingly difficult to do so unless town-planning experts are brought in from other countries and employed by Canadian municipalities. The only other alternative is for the development of town-planning engineers in Canada. Several proposals for this purpose have been put forth, but little progress is being achieved. Some engineers hold that it is largely a question for the attention of our universities, who should work out suitable curricula leading to a degree, which would be granted by the engineering faculties. Other engineers are strongly of the view that the development of town-planning engineers should be worked out through The Engineering Institute of Canada.

If something constructive, which will lead to the production of properly qualified town-planning experts within a few years, is not attempted, the inevitable result will be the introduction into Canada of foreign engineers to do work which should be undertaken and can best be accomplished by our own citizens if properly qualified. It is up to the members of The Engineering Institute to deal with this question actively and without delay.

Report of Council Meeting.

At a special meeting of the Council, held on Wednesday, August 28th, at 5 p.m., the following elections and transfers were effected:—

Members: Charles Chambers, inspecting engineer, Irrigation Branch, Dept. of the Interior, Calgary, Alta. Frederick R. Faulkner, professor of civil engineering, Nova Scotia Tech. Coll., Halifax, N.S. James J. McArthur, His Majesty's International Boundary Commissioner, Ottawa, Ont. Robert S. Stockton, in charge of Western Section, C.P.R., Dept. of Nat. Res., Strathmore, Alberta.

Associate Members: Kenneth R. Ayer, Supt. Gauge Laboratory, Imperial Ministry of Munitions, Ottawa, Ont. William J. Ireland, asst. ch. eng. of Manitoba Hydrometric Survey, Water Power Branch, Dept. of the Interior, Winnipeg, Man. Ira P. McNab, mechanical supt., Nova Scotia Tramways & Power Co., Halifax, N.S. Harold S. McKean, of Halifax, N.S., at present overseas, Lieut. 2nd Division Officer, Royal Canadian Engineers. Norman A. Yarrow, general manager, Yarrows, Limited, Victoria, B.C.

Juniors: Joseph C. Ells, of Halifax, N.S., with Canadian Geological Survey. James A. M. Penrose, asst. road engr., Good Roads Board, Winnipeg, Man.

Transfer from class of Associate Member to Member: John Wm. Porter, chief engineer, H.B.Rly., The Pas, Man. John M. Wilson, dist. engr. at Toronto, in chg. of all Dominion Government Public Works in central Ontario, Toronto, Ont.

Transfer from class of Junior to Associate Member: Humphrey S. Grove, plant engineer, Dominion Bridge Co., Lachine, Que.

Transfer from class of Student to Junior: William H. Slinn, assistant to C.R.C.E., Military District No. 3, Kingston, Ont.

Late Lieut. Geo. M. Scott, R.N.A.S., S.E.I.C.

Lieut. Geo. M. Scott, B.Sc., Killed in Action.

Word has been received by his parents, Mr. and Mrs. R. M. Scott, of 250 Westmount Boulevard, that Lieut. George M. Scott, R.N.A.S., S.E.I.C., had been killed in action while serving with the 62nd Wing Aegean Group. His brother, Lieut. Gordon D. Scott, R.N.A.S., S.E.I.C., is now Overseas.

The late Lieut. Scott is a graduate of McGill University in Science in 1917, having been born at Lakeside twenty-one years ago. He was a member of the Y.M.C.A., Phi Delta Theta Fraternity, Valois Boating Club and the Montreal Ski Club.

In writing to his parents Lieut. Scott's Observer gives information concerning his death.

"You will I trust pardon my writing to you, but I felt that you would like to know something of the circumstances attending the death of your son, of which you will probably have heard by now. I feel that I am particularly fitted to write about him as I have known him since his arrival in England when we became more than friends, and again here in the Aegean. He honoured me by asking for me to be his Observer, and I have accompanied him on every raid he has taken part in also several patrols and other flights. We became very much attached to each other, and I always found him a very cool, steady and courageous Pilot, these good points having got us out of several tight corners, and I never wished to be with a better pilot, and I feel the loss of him very much indeed.

"On the day of his death, he had carried out a dawn patrol accompanied by a wireless mechanic, and just as he was about to land on the aerodrome his machine struck an obstacle which was probably invisible in the early dawn, and nose-dived to earth. It will be some consolation to you and his people to know that your son suffered no pain, for both he and his Observer were instantaneously killed. The accident was an instance of a good Pilot meeting his death through sheer bad luck. Mr. Scott was a real good sort and was very popular both with the officers and mechanics, and I am certain you have the sympathy of all with whom he came in contact."

Preliminary Notice of Application for Admission and for Transfer

28th August, 1918.

The By-Laws now provide that the Council of the Society shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to Secretary any facts which may affect the classification and election of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described on 24th September, 1918.

FRASER S. KEITH, Secretary.

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*The professional requirements are as follows:

Every candidate for election as MEMBER must be at least thirty years of age, and must have been engaged in some branch of engineering for at least twelve years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in some school of engineering recognized by the Council. The term of twelve years may, at the discretion of the Council, be reduced to ten years in the case of a candidate who has graduated in an engineering course. In every case the candidate must have had responsible charge of work for at least five years, and this not merely as a skilled workman, but as an engineer qualified to design and direct engineering works.

Every candidate for election as an ASSOCIATE MEMBER must be at least twenty-five years of age, and must have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineers' office, or a term of instruction in some school of engineering recognized by the Council. In every case the candidate must have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years.

Every candidate who is not a graduate of some school of engineering recognized by the Council, shall be required to pass an examination before a Board of Examiners appointed by the Council, on the theory and practice of engineering, and especially in one of the following branches at his option Railway, Municipal, Hydraulic, Mechanical, Mining, or Electrical Engineering.

This examination may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five years or more years.

Every candidate for election as JUNIOR shall be at least twenty-one years of age, and must have been engaged in some branch of engineering for at least four years. This period may be reduced to one year, at the discretion of the Council, if the candidate is a graduate of some school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-five years.

Every candidate who is not a graduate of some school of engineering recognized by the Council, or has not passed the examinations of the first year in such a course, shall be required to pass an examination in the following subjects Geography, History (that of Canada in particular), Arithmetic, Geometry Euclid (Books I.-IV. and VI.), Trigonometry, Algebra up to and including quadratic equations.

Every candidate for election as ASSOCIATE shall be one who by his pursuits, scientific acquirements, or practical experience is qualified to co-operate with engineers in the advancement of professional knowledge.

> The fact that candidates give the names of certain members as references does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

BATEMEN—EDWARD FLEMING, of Saskatoon, Sask. Born at Mirfield, Eng., Aug. 1st, 1854. Educ. Victoria Coll., Jersey; Kings Coll., London & Thames Marine Officers Training Ship; engineering experience covers a period of over forty years as follows: apprenticeship with the late J. F. L. Bateman, Past President, Inst. of C. E., London; 3 yrs. with Jas. Watt & Co., Birmingham, drawing, fitting & erecting all heavy machine work; 2 yrs., dftsman and manager with Lambeth Engineering Co., London, on general engineering, engines, boilers and structural work; in private practice as follows: engr. for Flintshire Water & Gas (Session 1883), Haslingden Water Suply, City of Chester re-distribution, Luton drainage; 10 yrs. ch. dftsman to Commissioners of the Irish Lights; 1910 to date, engaged on erection of the structural steel and bunkers at new power house, re-construction of pumping station, etc., Saskatoon, Sask.

References: C. J. Yorath, H. McI. Weir, J. E. Underwood, A. A. Murphy, A. R. Greig.

BENE MARIUS EUGENE, of Montreal. Born at Geneva, Switzerland, 13th June, 1886. Educ. Applied Science, Geneva, 1904 (five years); 1905-6, supt for Hamon & Hess, marble tile and slate contractors; 1907-8, estimator and supt. for Smith Marble & Construction Co.; 1909-14, in the same capacity for Robert Reid Marble Works; 1914-16, engr. on design and supervision and supt. of construction for the Canadian Siegwart Beam Co.; 1916 to date, engr. supt. of constrn. for the Provincial Building & Engineering Co., Montreal.

References: P. leCointe, A. Frigon, S. A. Baulne, J. E. Bertrand, J. Irwin, C. Brandeis.

BISHOP—WATSON LANLEY, of Dartmouth, N.S. Born at Kentville, N.S., 6th Sept., 1845. Educ. common school. 31 years in engineering work, as follows: 1887-1892, in chg. of streets and waterworks, Kentville, N.S.; 1892-1913, in chg. of streets, sewers and waterworks in Dartmouth; 1913-18, highway engineer, Province of Nova Scotia; 1918, district engineer, highways, seven western counties, Province of Nova Scotia.

References: W. G. Yorston, H. Donkin, D. McD. Campbell, K. H. Smith, C. A. MacNearney, F. A. Bowman.

HART—PERCY EDWARD, of Toronton, Ont. Born at Turnchapel, near Plymouth, Eng., 9th Jan., 1870. Educ. matric. and subsequent courses of study. 1889-91, in chg. of small electrical plant; 1891 until the present time with the Edison Electric Co., commencing as constrn. foreman and since 1893 with the Canadian General Electric Co. when that firm was taken over; as supt. of constrn. for the Halifax dist. until 1895; 1895 to 1901, supervising installation of the larger and heavier contracts; in 1901 transferred to the head office engr. staff; 1905 to 1913, estimating engr. on the Head Office Agency Dept.; 1913 to date, managing engineer, with the Toronto Hydro Electric System, in chg. of all engineering matters in constrn., operation and design.

References: R. A. Ross, R. S. Kelsch, W. Chipman, W. G. Chace, J. Murphy, J. Milne, A. L. Mudge, W. A. Bucke.

JOHNSTON—KEITH PRUYN, of Saskatoon, Sask. Born at Centreville, Ont., 5th Feb., 1890. Educ. B.A., B.Sc. (Honors) Queens Univ., 1912, 1915 (civil engr. and elec. engr.) Summers 11-12, pattern shop foundry and electrical assembly, Allis-Chalmers-Bullock Ltd., Montreal; summer 1913, timekeeper, with Bithulithic & Constrn. Co. Ltd., Edmonton; 1915-18, lecturer in mathematics in Faculty of Ap. Science, Queen's Univ.; 1916-18, lecturing on Geodetic surveying; summer, 1915, engr. with Kerry & Chace, making surveys in connection with hydro-elec. power sites; summers 1917-18, engr. with Murphy & Underwood, Saskatoon, on general engineering work, (to date.)

References: A. A. Murphy, J. E. Underwood, J. C. Gwillim, G. L. Guillet, D. A. R. McCannel.

KENT—EDWARD SHERBURN, (Lieut. on active service.) Born at Truro, N.S., Mar. 1st, 1878. Educ. B.Sc., N.S. Tech. Coll.; transitman, on sewer constrn., Truro, N.S.; transitman, on railroad constrn., C.P.Ry.; 1910-13, in chg. of inspection on numerous large bridges and office buildings; 1913-16, manager of Western Br., Canadian Inspection & Testing Laboratories Co. Ltd.; 1916 to date, Lieut. Royal Engineers, Italy.

References: E. E. Brydone-Jack, A. McGillivray, P. Burke-Gaffney, M. A. Lyons, E. W. M. James.

MACDONALD—GORDON SCOVIL, of St. John, N.B. Born at St. John, Oct. 22nd, 1887. Educ. B.Sc., Univ. of N.B.; 1905, (3 mos.), leveller on location, N. B. Southern Ry.; 1906, (6 mos.), leveller and dftsman, Atlantic Quebec & Western Ry.; 1907, dftsman, leveller & transitman on location, N.T.Ry.; 1907-8, int'man and dftsman, N. B. Southern Ry.; 1908-9, inst'man, N.T.Ry.; with C.P.R. as follows: 1910, (8 mos.), topographer; 1910-12, int'man; 1912-14, res. engr.; 1914, to date, dist. engr., Marine & Fisheries Dept., St. John, N.B.

References: W. P. Anderson, B. H. Fraser, H. Longley, D. Hillman, A. Gray, A. R. Crookshank.

MACKENZIE—WILLIAM DUNCAN, of Winnipeg, Man. Born at Brantford, Kansas, Oct. 26th, 1884. Educ. S.P.S., Toronto; 2 yrs., rodman, Trent Canal; (6 mos.), rodman, C.N.Ry.; 1907, (6 mos.), res. engr. on N. St. C. & T.Ry.; 1908-12, res. engr., C.N.Ry.; with G.W.W.D., as follows: 1913-14, (6 mos.), transitman; 1914-15, res. engr.; 1915-18, asst. divn. engr., at the present time, divn. engr.

References: W. G. Chace, G. F. Richan, D. N. Sharpe, R. W. Moffat, A. C. D. Blanchard, F. N. Rutherford.

MACTAVISH—WILFRID IAN, of Toronto, Ont. Born at Toronto, Ont., March 8th, 1892. Educ. S.P.S., Toronto; 1912, to date, asst. engr., Dept. of Public Works, Toronto, Ont.

References: W. P. Merrick, F. Moberly, J. M. Wilson, A. N. Molesworth, W. H. Blanchet.

NEHIN—FRANK O'BRIEN, of Montreal. Born at Buffalo, N.Y, 4th Feb., 1893. Educ. B.A.Sc., McGill Univ., 1916; 2 yrs., Faculty of Arts. Summers 1913-14,15, 16, rodman, instrumentman and engineer's asst., Montreal Harbour Comm'n; 1916-17, instrumentman, Mount Royal Tunnel; 1917-May, 1918, draftsman, Mich. State Highway Dept.; May, 1918, to date, chief of field party, Mount Royal Tunnel.

References: S. J. Waller, F. W. Cowie, A. F. Stewart, S. P. Brown, H. M. MacKay E. H. Brietzcke, J. P. Leclaire.

NIXON—RICHARD LEWIS, of Kentville, N.S. Born at Halifax, 1st July, 1888. Educ. B.Sc., King's Univ. and Nova Scotia Tech. Coll., 1916. Summers, 1912-13, clerk, draftsman, rodman, etc., engineer's office, Dominion Atlantic Ry.; summer, 1914, masonry inspector on substructure, Windsor Ry. bridge, over Avon River; summer, 1916, draftsman, designing small castings for box cars, in engineering dept. of Eastern Car Works, New Glasgow; summer 1917, asst. instrumentman and draftsman, D.A.R.; 1916-17-18, academic years, in chg. of engineering course, King's Coll., lecturing in mechanics, drawing (descriptive and machine) surveying and some mathematics, in absence of regular professor overseas.

References: M. K. MacQuarrie, F. A. Bowman, W. S. Ayars, F. W. W. Doane, G. G. Hare.

ROBB—AUBREY GRANGER, of Amherst, N.S. Born at Amherst, N.S., Oct. 4th, 1870. Educ. Mass. Inst. of Tech. 1890 to date, with the Robb Engineering Co. in various capacities. At the present time Superintendent and Chief Engineer.

References: G. H. Duggan, H. H. Vaughan, M. J. Butler, D. W. Robb, F. A. Bowman.

ROCCHETTI—JOSEPH, of Winnipeg, Man. Born at Fermo, Italy, 5th Aug., 1879. Educ. E.E., Liège, Belgium, 1905; Mech. Engr. Tech. High School, Fermo, 1889. 1905-10, elec. engr., Société Auxiliaire d'Electricité, Brussels; ch. engr. with the A.P.I.C.E.A., Paris, France, 1910-12; 1913-15, elec. engr. G.T.P.Ry.; 1916 to date, designing engr. and assist. to the prov. electrical engr., Public Works Dept., Man. Govt. (naturalized, Oct. 1916.)

References: J. G. Legrand, J. M. Leamy, G. L. Guy, E. V. Caton, F. H. Farmer.

SKOLFIELD—HERBERT NASON, of New Glasgow, N.S. Born at Harpswell, Me., Sept. 1st, 1887. Educ. B.S., Univ. of Maine; 1906-10, rodman, office work and other kinds of engineering work on surveys and city work; 1910-11, survey, plans and in chg. of contrn. of water system, Town of New Glasgow; 1912-13, on constrn. of plant, Eastern Car Co., New Glasgow, N.S.; 1914-15, in chg. of various surveys & constrn. of four miles of railroad; 1915 to June 1918, civil engineer for Eastern Car Co., New Glasgow, also work on design, constrn. and estimating of freight cars; June 1918, reported for service in U. S. Army.

References: R. E. Chambers, E. S. Fraser, F. W. Forbes, R. B. Stewart, W. G. Matheson.

STUART—WILLIAM JAMES, of Vancouver, B.C. Born at Vancouver, 9th Apr., 1889. Educ. Vancouver High School; Columbia Coll. (2 yrs.); McGill Coll., 1911; 1906-08, rodman and asst. draftsman, with City Engr., Vancouver; 1909, topographer, branch lines, Chicago & Milwaukee Ry., Idaho; 1910, topographer, C.N.P.Ry. in B.C.; 1912-14, res. engr. on constrn. of permanent pavements and roadways, Vancouver; 1914-18, on active service with the 3rd Field Co., Can. Engrs. in military engr. At the present time, 2nd Lieut. Royal Engrs.

References: F. L. Fellows, A. G. Dalzell, C. Brakenridge, W. H. Powell, A. Lighthall, A. McPhail.

WARREN—HECTOR DE LA GRANGE, of Pointe-au-Pic, Charlevoix, P.Q. Born at Pointe au-Pic, 22nd Apr., 1883. Educ. B.Sc., (C.E.), Queen's Univ., 1912-13; Quebec Coll., Politech. School, 1909; 1906-07, surveying, engineering and office work, Boucher & Demers, Montreal; 1910-11, asst. engr., Quebec & Saguenay constrn. (as student); 1913-14-15-16, with the Public Works Dept., as follows: 1913, asst. to the engr. in chg. of Murray Bay constrn.; 1914-15-16, borings, tests, surveying and supervision constrn. of concrete wall under water; 1915, in chg. of Quebec Harbour improvement; 1914, in chg. of Quebec dist. as acting district engr.; 1917-18, in chg. of proposed new waterworks system in Pointe-au-Pic.

References: A. Fraser, J. Gibault, A. B. Normandin, A. McPhail, L. Malcolm.

FOR TRANSFER FROM THE CLASS OF ASSOCIATE MEMBER TO THAT OF MEMBER

BURNETT—ARCHIBALD, of Swansea, Ariz. Born at St. Hyacinthe, Que., Nov. 29th, 1876. Educ. B.Sc., McGill Univ.; 1902, (5 mos.), assayer and assist. at mines of Dominion Copper Co., B.C.; 1908, (3 mos.), asst. to J. L. Parker, in chg. of development, The Vancouver Island Copper Co.; 1908-12, engr. and designer, B.C. Copper Co.; 1912-17, examining engr. and management of two subsidiary mines, Crown Reserve Mining Co.; 1917, efficiency engr. on Mine Methods Limited Verde Copper Co., Jerome, Ariz.; at the present time, general supt., Swansea Lease Inc.

References: J. A. Burnett, J. R. W. Ambrose, F. B. Brown, H. B. Stuart, A. Crumpton.

CRYSDALE—CECIL RAINSFORD, (M.C.), of Vancouver, B.C. (On active service.) Born at North Port, Ont., 28th Nov., 1883. Educ. Albert Coll. and 1st yr., S.P.S. Toronto; 1904, (8 mos.), rodman, on location and constrn. C.N.R.; 1905-06, section engr. and instrumentman, C.N.R. Feb. 1906-Mar. 1907, instrumentman and timekeeper, G.T.P.Ry.; (2 mos.), transitman on location, Manchester & Winona Ry.; 3 mos., res. engr. on constrn. C. B. & Chicago Ry.; June 1907-July 1912, with the C.P.R. as instrumentman and res. engr. and asst. engr., Medicine Hat section; Aug. 1912-Feb. 1916, asst. and div. engr., Pacific Great Eastern Ry., North Vancouver to Clinton. At the present time, Major, (M.C.), Can. Engrs., and Tramway Co., B.E.F.

References: J. M. Rolston, M. H. Macleod, J. Callaghan, W. A. James, W. Burns, F. P. Wilson, F. M. Young.

FOR TRANSFER FROM THE CLASS OF JUNIOR TO HIGHER GRADE

JAMIESON—WILLIAM TURNBULL, of The Pas, Man. Born at Glasgow, Scotland, Nov. 29th, 1884. Educ. West of Scotland Tech. Coll. [illegible], apprenticeship with Wylie & Blake, Glasgow, [illegible] sewage disposal works for various Scottish towns, 1908-11, [illegible] 1911-14, with N.T.Ry., as dftsman, inst.man & [illegible] with Hudson Bay Ry. as follows: 1915, res. engr.; 1916, divisional engr.; 1917 to date, div'n and office engr.

References: J. W. Porter, A. Ferguson, A. D. Porter, J. A. [illegible], A. D. Ferguson.

KENDALL—LESLIE EVANS, of New Glasgow, N.S. Born at Charlemagne, Que., Oct. 24th, 1887. Educ. B.Sc. Queen's Univ.; 1905-11, leveller and transitman, Militia Dept., Ottawa; 1912-14, asst. engr. and asst. res. engr., with H. Holgate, Montreal; 1915-16, with Irrigation Br., Dept. of the Interior, Ottawa; 1917 to date, asst. inspector of shell components in chg. of Maritime District, Imperial Ministry of Munitions.

References: H. Holgate, F. H. Peters, E. G. Horne, M. A. Kemp, E. S. Fraser.

LAMONT—ARCHIBALD WILFRID, of Winnipeg, Man. Born at Mount Brydges, Ont., Jan. 4th, 1889. Educ. B.A.Sc., Toronto Univ. 1910; 1909, apprentice, Westinghouse Electric & Mfg. Co., Pittsburgh; 1910, Power House Operator, Lake Superior Power Co.; 1910-13, sales engr., Can. Westinghouse Co. Ltd., Winnipeg; 1913, power engr. Toronto Hydro-Electric; 1913 to date, sales engr. and in temporar chg. Can. Westinghouse Co. Ltd., Winnipeg, Man.

References: H. U. Hart, G. L. Guy, W. P. Brereton, F. H. Farmer, E. V. Caton, J. A. Douglas, A. W. Smith.

MacISAAC—DONALD FRANCIS, of Sydney, N.S. Born at St. Andrews, N.S., 28th March, 1888. Educ. B.A.Sc. (civil engineering and architecture) St. Francois Xavier and Penn. universities; also Arts, Forestry and business. 1906-07, rodman, T.C.Ry.; 1908-09, field office draftsman; 1910, divisional office engr.; 1911, cost and accounting engr., Obrien, McDougall & O'Gorman, railway contractors; 1914, field engr., bridges and buildings, C.P.R. (6 mos.), and 6 mos. engr. Highway bridges, N.S. Public Works Dept.; 1912, field architect and engr. railway building constrn. G.P.T.; 1913, constrn engr. and supt. of works, railway yard, water and sewer systems, O'Brien, McDougall, O'Gorman; 1915, (4 mos.), cost, management and designing engr., Colonial Lumber Co., (8 mos.), as field engr. on surveys and constrn. of Highway bridges; 1916, (4 mos.), ch. inspector and asst. to mechanical engr. on 4.5 shell finish, Eastern Steel Co. Ltd., (8 mos.), engr. of bridges, Public Works Dept., N.S.; 1917, (6 mos.), forestry surveys and valuations and estimates, Colonial Lumber Co.: June 1917 to date, estimating engr. mechanical and contrn. dept., Dominion Iron & Steel Co.

References: W. D. Robertson, N. G. Yorston, H. Donkin, C. O. Foss, H. F. Lawrence.

YOUNG—RODERICK BEARCE, of Toronto, Ont. Born at Minneapolis' Minn., Apr. 24th, 1891. Educ. B.A.Sc. Univ. of Toronto; summers 1907-10, railroad, constrn. in minor capacities; summers 1911-13, apprentice, Canadian Westinghouse Co.; with Hydro-Electric Power Commission as follows: 1913-15, electrical and mechanical testing and research; 1915 to date, asst. laboratory engr.

References: H. G. Acres, M. V. Sauer, A. C. D. Blanchard, J. B. Goodwin, E. B. Merrill, T. H. Hogg, N. R. Gibson, P. Gillespie.

FOR TRANSFER FROM THE CLASS OF STUDENT TO HIGHER GRADE

HORNSBY—LESLIE HENRY, of Toronto, Ont. Born at Montreal, Que., July 23rd, 1890; 1907-9, dftsman, John McDougall Caledonian Iron Works; 1909-10, with Locomotive & Machine Co., Montreal; 1910-13, with G.T.Ry.; 1913 to date, designing dftsman, Toronto Terminals Ry., Toronto.

References: J. R. W. Ambrose, A. S. Going, A. Crumpton, H. B. Stuart, E. G. Hewson, H. W. McAll.

LAKE—NORMAN JOHN, of Markdale, Ont. Born at Brantford, Ont., July 28th 1896. Educ. McGill Univ.; 1914, in chg. of core-truckers, Pratt & Letchworth Co., Buffalo; 1915, asst. to ch. inspector of munitions, Steel Co. of Canada, Brantford; 1916, (3 mos.), in chg. of cable installation, Abitibi Power & Pulp Co., Iroquois Falls, Ont.; 1916-18, on installation of electrical machinery, Canadian Westinghouse Co.; 1918, (4 mos.), dftsman, Dom. Steel Products Co., Brantford, Ont.; at the present time, installing electrical apparatus, Canadian Westinghouse Co.

References: C. V. Christie, J. B. Porter, L. A. Herdt, E. Brown.

LAYNE—GEOFFREY FRANCIS, of Cheshire, Eng. Born at Barbados, B.W.I., Feb. 21st, 1892. Educ. B.Sc. McGill Univ.; 6 mos. with D. M. Simpson & Co., Barbados; 9 mos. supt., Public Works, Barbados; 3 mos. surveying, Shawinigan Water & Power Co.; 6 mos. with C.P.R.; at the present time, Lieut. Royal Feld Artillery, instructional duty.

References: J. W. Harkom, C. M. McKergow, A. R. Roberts, E. Brown.

SZAMMERS—CHARLES FRANKLIN, of Toronto, Ont. (On active service.) Born at Toronto, Ont., Oct. 9th, 1888. Educ. S.P.S., Toronto; with T. & N. O. Ry. as follows: 1909-12, on maintenance constrn.; 1913, asst. engr.; 1914-15, engr. for Sherwood & Sherwood; 1916 to date, chief of constrn. and maintenance of Canadian Corps Tramways in France and Flanders.

References: S. B. Clement, P. Gillespie, T. R. Loudon, R. Winslow.

CORRESPONDENCE

A Simple Method to Obtain the True Bearing of a Line

Editor, *Journal*,

In the July number of the *Journal of the Engineering Institute of Canada* there appeared an article on a means of obtaining the true bearing of a line by means of a table giving the position of the pole star. The Topographical Surveys Branch of the Dpartment of the Interior issue a table similar in its application but different in its form and requiring much less interpolation than the one proposed by Mr. Lovelace. Interpolation for the date is avoided by taking a mean position of the pole star over a certain period. In the tables prepared by the Surveys branch the periods are so selected that the maximum error possible is less than 0.5; this maximum error is found only on the days at the limits of the tables and at certain hours of those days; at other times it is quite inappreciable. Interpolation is thus confined to latitude and to time; the former is given for every 2° from 40° to 56° and the latter for every 10 minutes of sidereal time.

Mr. Lovelace has limited his table to three hours in the evening. With the transits used on Dominion Lands surveys, the pole star can be seen at any time on a clear day; with the average instrument used by engineers it should be seen a little after sunrise and a little before sunset. To discover a star in the daytime requires a little practise, but once found it is easy to pick up again. In the first place it is essential that the telescope be accurately focussed for a distant object; then it must be so directed as to bring the star within the field. After clamping the telescope in the proper direction and carefully scanning the field, it may be a minute or more before the star is perceived as a little speck of light. A quick moving star is more easily found than one which moves slowly; the motion of the pole star being almost imperceptible, a little movement to and fro given to the telescope by means of the tangent screw of the horizontal plate helps in perceiving it. Once found, it appears so plain that it is always a subject of surprise that it was not seen before.

The direction in which to point the telescope in order to find the star is obtained as follows:—The setting in altitude is taken from a column of altitudes in the tables; the horizontal circle is set to the bearing shown in the tables for the time of observation and the upper plate clamped, the lower plate is released and the instrument set in the approximate meridian by means of the compass.

I may add that observing on the pole star in daytime has been a general practise on Dominion Lands surveys for forty years and surveyors have been using the tables for the past fifteen years. Any member of the Engineering Institute who is interested may obtain copies of the tables and a folder giving full explanations of their use upon application to the Surveyor General, Department of the Interior.

G. BLANCHARD DODGE, M.E.I.C.

Mineral Resources.

Editor, *Journal*,

I notice on page 125 of the July issue of the *Journal of the Engineering Institute of Canada*, you have a paragraph anent the "Imperial Mineral Resources Bureau" which is worthy of the closest attention of the Dominions and Colonies of the Empire.

You quote that the duties of this Imperial Mineral Resources Bureau are to be the "collection of information regarding the (1) mineral resources and (2) the metal requirements of the Empire," and you point out that seven out of the twelve members are appointed by the Home Government, that Newfoundland has an equal representation with Canada, and that the Board evidently is "loaded" in favor of the Old Country.

That you are correct in thinking that the politicians will outnumber the technical men on this Board, time will show. Not being of as modest a nature as yourself I may predict its comparative uselessness as a consequence.

You point out, in your last paragraph, why this matter is worth our closest attention namely, because of the probable direction that may be given to its activities, to provide sources of *raw material* for the benefit of *manufacturers in Great Britain.*

If you are correct in your interpretation of the significance of this Imperial measure it is, in its last analysis, a repressive influence upon the development of these Dominions into self-sustaining countries; it will prevent, in large manner, the growth of manufacturing interests in the Colonies, and will tend to centralize the domination of all manufacturing industries in the hands of the manufacturers of Great Britain. Distinctly it is not in the line of *independence*, it is rather in the nature of a shackle, a binding chain.

Canada has been an exporter of raw and crude materials too long, and to her great detriment. Any organization that looks forward to throwing this Dominion back into the condition of hewers of wood and drawers of water for the benefit of others rather than ourselves, should be energetically squashed.

We have only become refiners of our crude copper and spelter since this World War began, we have yet many other metals and metallic products to be refined and manufactured before sale of them can be made to the best advantage of the country producing them.

I am no advocate of protection, I believe that each industry should be made capable of standing on its own feet without props from the Government, if possible. But I have yet to know of any country that has grown powerful as an exporter of crude material; it is the manufacture of crude materials into the finished products that produces the profit, that employs labor, that increases the population, that requires sustenance from the home farmer, and that, finally, creates a nation's wealth.

It is to be hoped that your fear is ill-advised, but one must express his appreciation of your caution.

Yours truly,

JOHN E. HARDMAN, M.E.I.C.

Winnipeg Power Plant.

Editor, *Journal.*

With reference to the article by Mr. Glassco and myself in the July issue of the *Journal* I would call your attention to some typographical errors which have entered into this article, which are undoubtedly due to the copy you received from me not having been corrected. This was unfortunately an oversight on my part as I had had both copies of the paper gone over with instructions to correct all errors.

The following errors are of the most consequence:

Page 116, col. 2, line No. 37, should read: "Exit of Draught tube."

Page 117, col. 1, line 16, from the bottom should read: "Except at dead end towers, and special structures, etc."

Page 117, col. 2, line 28 from the top should read: "6000 K.V.A." instead of 5000.

Page 119, col. 1, line 2, should read: "When excited at 2300 volts."

Page 119, col. 1, line 6, should read: "Primary excited."

Page 119, col. 1, line 10, should read: "With the induction regulator, etc."

Page 119, col. 2, the third paragraph from top should read: "The loss between the terminal station 12,000 volt bus and the consumers meters is 10.8 percent of the K.W. hours delivered to the 12,000 volt bus at the Terminal, as this loss includes some 143 flat rate consumers consumption who are not metered.

Page 119, col. 2, line 23, should read: "V.P.H. bus."

In the tabulations given under the statistics of the distribution system, the following might be made plainer:

"Connected load per consumer, in City, Light and Heat—1.075 K.W."

"Transformer Capacity per consumer, in City, Light and Heat—.67 K.W."

"Transformer Capacity in City, A. C. Power per consumers—19.5 K.W."

"Total connected load on System—56,000 K.W."

"Connected load per consumer—1.62 K.W."

Yours truly,

E. V. CATON,

Chief Engineer.

* * *

Ready to Push or Pull.

Editor, *Journal*:

After going over the three numbers of the Journal very thoroughly I wish to congratulate you for the "pep" shown in the efforts of the Institute to further the interests of the Engineering Profession—if we can already call it a profession. It is surely a step along right lines and, though belated, should produce results pleasing to all of us. We are all with you and ready to either push or pull as may seem necessary.

Yours very truly,

N. L. SOMERS, A.M.E.I.C.

Appreciation from France.

FRANCE 21/8/18

Dear Editor:

To say that I am delighted with our new *Journal* is to express it mildly. A copy of Vol. 1 No. 1 reached me yesterday and I feel I must write a note of thanks.

I can quite appreciate the troubles you had, as Editor, in producing such a fine first edition, as back in 1911-12, while in my final year at the Engineering Dept. of the University of Manitoba, I inaugurated and was first Editor of a rather ambitious technical college magazine called, "The Manitoba Engineer." You really are to be congratulated on your good start. I sincerely hope you can keep it up and improve, if possible.

Am certainly pleased at the new movement in the Society, the change in name, etc. and you may rest assured of any support it is in my power to give. If I see a chance any time to do useful missionary propaganda work in supporting the principles of the Institute I always gladly do it and consider it a duty. I have always felt it an honour to belong to the Canadian Society of Civil Engineers and feel it more so now that the Institute is taking over and carrying on. It should be a powerful force in stimulating Canadian professional engineers to unified effort and to increased prestige and public recognition. On my return to Canada after the War I solemnly purpose being an ardent Institute supporter in as active a manner as possible.

Perhaps you will be interested to know that I am now attached to the staff of the Engineer-in-chief at the General Headquarters of the British Armies in France,—not as a staff officer (red tabs) but as a technical assistant on certain important special survey reconnaissance work. This work, connected with defence schemes, carries me to all sorts of places behind the British line, from one end to the other and I am certainly seeing big things all the time. Considering that I have been in France only a few months I consider myself very favoured as the work is quite congenial and very interesting. It is educational also. My O.C. at G.H.Q. is an irrigation expert from the famous Indian Public Works Dept. and as my education and training have been, of course, along Canadian and American lines the interchange of ideas is, I believe, mutually instructive. What a meeting place and melting pot and Empire cradle Northern France is these days! Nothing but good can come to us out of all this agony.

I meet very few Canadian engineers now but manage to keep in some sort of touch with my old work through letters, occasional papers and the Canadian Engineer and Engineering News-Record.

With best wishes to you in your important work, I am,

Yours very truly,

GORDON L. SHANKS,

2nd Lieut. R.E., A.M.E.I.C.

Personals.

A. S. Clarson, A.M.E.I.C., who has been City Engineer for the city of Verdun for the past two years has handed in his resignation to the Council of that city.

* * *

Major G. Eric McCuaig, D.S.O., A.M.E.I.C., who returned to the front a few months ago after a visit to his home in Montreal has been interned in Holland. It is hoped that he will be exchanged within the next few months and it is possible that he may be home before Christmas.

* * *

Wm. McNab, M.E.I.C., valuation engineer, Grand Trunk Railway System, received a cable recently that his son, Cpl. Wm. Stuart McNab had been wounded for the second time. Cpl. McNab's twin brother, Cpl. Gordon K. McNab is serving with the same battery, and their older brother, Lt. Lewis G. McNab, who went overseas in February 1915, is at present with a corps of heavy artillery in France.

* * *

Major J. R. Grant, M.C., M.E.I.C., who was reported missing some time ago is now reported a prisoner of war in Germany. Major Grant's address as furnished by his sister, Miss Helen Grant of the staff of the University of Saskatchewan is: Offizier, Gefaulgenenlager, Stralsund, Danholm, Germany, where communications from his many friends in the engineering profession may reach him.

* * *

Major H. P. Stanley, D.S.O., Jr.E.I.C., who was severely wounded in the battle of Vimy Ridge and who has for the past year been Principal of the Vocational School for returned soldiers in Montreal, has resigned his position to re-enter civilian life. His leaving was the occasion for the presentation of an illuminated address and an office desk set from his fellow officers. Major Stanley has joined the Royal Insurance Company as an inspector for the Province of Quebec, being physically unable to return to his former profession of civil engineering.

* * *

A. R. Dufresne, M.E.I.C., who has been assistant chief engineer of the Department of Public Works since 1908 has resigned his position and accepted the managership of the St. John Dry Dock and Shipbuilding Company of St. John, N.B. This position is an important one and involves unusual responsibility as the Company is under contract with the Government to construct a drydock of the largest class also a breakwater and to dredge a channel and basin in the St. John harbor. This work will run into several millions of dollars and is the largest single piece of construction work that the Public Works of Canada has at present under way.

Deputy Director of Public Works.

S. J. Fortin, M.E.I.C., who has for a number of years been giving his services to the Government in the Public Works Department, has accepted the position of deputy director of public works of the City of Montreal, at a salary of $4,200 per year. Mr. Fortin's appointment which includes that of deputy chief engineer, to take charge of the roads, sewers and surveying departments, was made by the Administrative Commission of the City.

Irrigation Superintendent.

Sam G. Porter, M.E.I.C., has been recently appointed Superintendent of Operation and Maintenance of the Lethbridge Irrigation System with headquarters at Lethbridge, Alberta. Mr. Porter is one of the most active members of the Engineering Institute of Canada and the American Society of Civil Engineers, and is eminently fitted for this position from having made a speciality of irrigation in all its phases practically all his life. He was born in Texas in 1876 and is a graduate of the Massachusetts Institute of Technology in Boston, and the Baylor University, Texas. His experience has been varied and practical, including 2½ years in the United States Reclamation Service, and 6½ years as Chief Engineer of the Arkansas Valley Sugar Beet and Irrigated Land Co., one of the largest Irrigation companies in Colorado. During the past 5 years he has been Assistant Chief Engineer and Acting Commissioner of Irrigation in the Department of the Interior at Calgary. Mr. Porter in his new appointment reports direct to A. S. Dawson, Chief Engineer, Department of Natural Resources, C.P.R. at Calgary.

Important Executive Appointment.

By the appointment of Richard A. Sara, M.E.I.C., as an executive of the American Cellulose and Chemical Manufacturing Co., 681 Fifth Ave., New York, the Manitoba Branch is losing one of its most prominent and active members, as he has been intimately connected with the Branch for a number of years and has presented two valuable papers.

The plant of the Company is situated at Cumberland, Maryland, the Company having purchased four hundred and fifty acres for their accommodation. The plant will be built in five units, at a total cost of approximately five million dollars. The first unit is under construction at present by the Fuller Company of New York, at a cost of approximately $1,000,000. The Company intend manufacturing chemicals for treating aeroplane wings, and the same material can be used for non-inflammable moving picture films.

Members of the Institute will be pleased to note of this tribute to Mr. Sara's ability.

Morley Donaldson Dead.

Morley Donaldson, M.E.I.C., formerly vice-president and general manager of the Grand Trunk Pacific, died at his home in Ottawa on August 27th, 1918. Born in Musselborough, near Edinburgh, Scotland on May 18, 1851, he came to Canada as a young man and entered the works of E. Gilbert & Company, Montreal, where he remained for two years. From 1871–1876 he was associated with Walter Shanly on the Hoosac Tunnel in Massachusetts. During the next four years he engaged

in mining in Colorado. In 1881 he became chief draughtsman of the Canada Atlantic Railway. At the time of becoming a member of the Institute in 1889 he was mechanical superintendent of the Canada Atlantic Railway and was later made general superintendent. With the merger of the Canada Atlantic and the Grand Trunk Railway System in 1905 he became superintendent of the Ottawa division of the Grand Trunk and in 1912 was appointed vice-president and general manager of the Grand Trunk Pacific Railway.

Greatest regret is expressed in engineering and railway circles in the death of one who has been so closely allied with the engineering and transportation development of Canada.

New President, Nova Scotia Steel & Coal Co.

Owing to the resignation of F. H. Crockard, M.E.I.C., from the presidency of the Nova Scotia Steel & Coal Company, D. H. McDougall, M.E.I.C., Councillor, who has been general manager of the Dominion Steel Corporation, has been appointed president and general manager of the Nova Scotia Steel & Coal Company. Mr. McDougall's qualifications for his new position are unique. His training includes a first hand knowledge of the iron ore mines in Newfoundland, of coal mining conditions and of steel manufacture, in addition to an engineering experience of a wide and varied character. More important than all, is his knowledge of men, for, as he was born and brought up in Cape Breton, and has worked with his hands as well as his brain, he has an intimate and sympathetic knowledge of the conditions under which workmen live in Nova Scotia, and in nothing has his record been so conspicuous as in his skilful and fair dealing with labor matters.

Mr. McDougall was appointed Assistant General Manager of the Dominion Coal Company in 1909, and his first achievment was the settlement of the strike then in progress. A year later, he succeeded in closing the protracted stoppage of work at Springhill Mines.

During the term of Mr. McDougall's management of the Dominion Coal Company at Glace Bay an extensive program of expansion was carried out. New coal mines were opened up and equipped with the most modern machinery, central power stations conceived and installed and all auxiliary operations co-ordinated resulting in an increase of the output of coal from three and a half to five million tons annually.

As a result of the extensions which have been carried out under Mr. McDougall's direction at Sydney, which include two new batteries of the very latest type of by-product coke ovens, and a modern blast furnace, it is expected that within a few months, or just as soon as the new ovens begin to produce coke, that the production of ingot steel will rise to at least 35,000 tons per month, and that new and much higher records in steel production will be made before long. Since his appointment as general manager of the Steel Corporation, Mr. McDougall has successfully guided the operations of this large enterprise through a period marked by quickly changing business conditions, by an unexampled shortage of labor, and by great hindrances to transportation, arising out of the shortage of vessels and war restrictions.

Irrigation Meet at Nelson.

One of the most important gatherings having to do with food production in Western Canada has just come to an end at Nelson, B.C., where the Western Canada Irrigation Association held its twelfth annual convention on July 24, 25, and 26. The selection of the city of Nelson for such a convention is in itself an indication of the growing interest which Western Canadians feel in irrigation as a means of increasing agricultural production. Nelson is not in the arid or semi-arid belt, and yet, even with the generous rainfall which prevails there, irrigation has been found to be of great value. The experience at Nelson seems to indicate that in years to come many districts which do not now recognize the need of irrigation will employ it extensively.

The accredited delegates numbered 182, besides many visitors, which, with one exception, is the largest attendance at a convention of the Association in the last five years.

The necessity for making provision for meeting our national obligations—which provision can be made only by increased production — was emphasized by Hon. John Oliver. Dry farming, irrigation, and every other method of production must be employed to this end. Financial problems after the war would be greater than during the war, and it was of the utmost importance that the Canadian people should produce more and consume less. Other addresses of a high order were heard, the speakers representing points from Ottawa to Victoria. The election of officers resulted as follows:

Hon. Patron: His Excellency the Governor General of Canada.

Hon. President: The Hon. Minister of the Interior of Canada.

1st Hon. Vice-President: Hon. W. E. Motherwell, Minister of Agriculture, Saskatchewan.

2nd Hon. Vice-President: Hon. Minister of Lands, British Columbia.

President: The Minister of Agriculture, Alberta.

1st Vice-President: Senator H. Rostock, Ducks, B.C.

2nd Vice-President: C. R. Marnoch, President Board of Trade, Lethbridge, Alberta.

3rd Vice-President: Hon. Minister of Agriculture, Canada.

Executive

Deputy Minister of Agriculture, Regina, Sask.
G. Sterling, Kelowna, B.C.
Deputy Minister of Agriculture, Victoria, B.C.
Jas. Johnstone, Nelson, B.C.
Walter Huckvale, Medicine Hat, Alberta.
F. H. Peters, M.E.I.C., Calgary, Alberta.
A. S. Dawson, M.E.I.C., Calgary, Alberta.
R. J. C. Stead, Calgary, Alberta.
F. E. R. Wollaston, Vernon, B.C.

Invitations to the Association were received from Brooks, Alberta; Medicine Hat, Alberta; and Lethbridge, Alberta, to hold the 1919 convention at these respective centres. The invitation of Medicine Hat was accepted.

EMPLOYMENT BUREAU

A Clearing House of Engineering Positions in Canada.

This Highly Paid Profession.

Definite information as to the average rewards in income to be gained from the various so-called professions is disclosed by the official analysis of the federal income tax payments in 1916. It appears that the highest average income was earned by engineers, although the legal profession held first place in aggregate income. While the conclusions are drawn from the rigid classification of incomes above the minimum established by the federal income tax law, and therefore are based on incomplete data, it is probable that the inclusion of the lower incomes would not affect the results. That engineering of the highly professional sort pays large returns is apparent enough from the rush of students to engineering schools in the past 30 years. *Springfield Republican, Springfield, Mass., Aug. 8, 1918.*

Situations Vacant.

Mining Chemist.

Mining chemist capable of making assays of all minerals and of looking after the chemical requirements of a mining corporation. Address applications to Box No. 5.

Works Engineer.

One capable of taking off accurate quantities for mechanical equipment from engineers' drawings and who has a fair idea of the cost of various machine shop operations, pattern making, and the installation of steam lines, shafting and general mill equipment. This position offers $130.00 to $150.00 per month to start and promises a good opening later. Address Box No. 8.

Inspectors.

Three inspectors for dock construction, pile driving and concrete work, and one timber inspector, required by Steel Corporation. In writing, give experience, salary expected, age and standing in regard to military service. Apply Box No. 10.

Draftsman.

Draftsman for railway office in New Brunswick. A young man who is willing to work his way upwards. Apply Box No. 11.

Instrumentman.

At once, competent instrumentman wanted for Canadian Government Rlys. Apply Box No. 12.

Draftsmen.

Wanted by large shipbuilding corporation, competent draftsmen for structural, mechanical and marine work. This work is important from a military point of view and offering liberal terms. Only first class men wanted. Apply to Box No. 13.

Instrumentman.

An experienced instrumentman wanted, preferably a young university graduate, for the Engineering Department of a railway company in Quebec Province. Address Box No. 15.

Draftsmen.

Several mechanical draftsmen required for Steel Corporation. Apply Box No. 16.

Transitman.

For temporary work with railway office, experienced transitman for Montreal and vicinity. Address Box 18.

Testing Expert.

Wanted by Ordnance Department of United States Government, mechanical engineer familiar with micrometer and heat testing methods to be employed in Canada. young college graduate preferred. Address Box No. 17,

Junior Civil Engineers.

Atlantic Coast, U.S. Railway requires two or three civil engineers for work in connection with Federal Valuation, preferably those who have had some railway experience and who can do ordinary drafting. The work required is locating land on the ground from deed descriptions, preparing plats, also searching county records for title. The work will be carried on under the chief engineer of the railroad and could be done by returned men who are unfit for more arduous work. Address Box 19.

Vocational Instructor.

An engineering graduate in the Vocational Branch of the Department of Soldiers' Civil Re-establishment at a salary at the rate of $2,400 per annum. Applicants should have had five or six years practical experience, should be able to deal with both mechanical and electrical problems, be capable of laying out machinery shafting, etc., and writing up a complete and intelligent specification covering the installation of same. Address, Civil Service Commission, Ottawa, Wm. Foran, Secretary.

Town Manager and Resident Engineer.

A large industrial company requires a civil engineer capable of acting as resident engineer and town manager for a model town, which they propose building. Duties would cover superintendence of the installation of sewers and water works, construction of streets, looking after the inspectors of dwelling houses and other structures. Eventually he would take over social welfare work and develop into town manager. The initial development of the town is for about five hundred to six hundred people and the company intend to make it absolutely modern and comfortable to induce employees to settle in the new town. Salary to start from $200. to $250. per month. Address Box 20.

Engineering Draughtsman.

An engineering draughtsman in the Vocational Branch of the Department of Soldiers' Civil Re-establishment at a salary at the rate of $1,800 per annum. Preference will be given to draughtsmen experienced in both electrical and mechanical work and familiar with the laying out of machinery, shafting, etc., Applicants should be good letterers. Address, Civil Service Commission, Ottawa. Wm. Foran, Secretary.

THIRD GENERAL PROFESSIONAL MEETING.

Devoted to a consideration of the harbour and shipping problems of the Maritime Provinces, Halifax, September 11th, 12th and 13th, 1918.

First Session
9.30 a.m., Wednesday, September 11th, 1918.

OWING to the train from St. John being late, it was a few minutes past 10 o'clock when President H. H. Vaughan declared the Third Professional Meeting of the Institute open and asked Lieutenant Governor Grant to address the meeting.

Lieutenant Governor Grant:

Mr. President and Gentlemen of the Engineering Institute; as Lieutenant Governor of the Province I extend to you a very warm welcome, and as a citizen of Halifax I greet you to this dear old City of Halifax by the sea.

I want to say to you, that if there is anything I can do for you, you have only to inform your Secretary and he will command me. I fancy of all men in the world, the engineer is a judge of human character, and therefore it is quite unnecessary for me to say that I am neither an engineer or the son of an engineer. My friend, C. E. W. Dodwell is the person of the Institute whom I know best. For a number of years he has been by warmest friend and I can say to you all that if you are of the same calibre as Mr. Dodwell, you are all right. I know that you are very busy men with meetings and sessions before you, and I am not going to take up your valuable time, but it will afford me great pleasure if I can in any way be of service to you.

The Mayor has asked me to say a word for him to you. On account of the meeting being late he could not remain. I cannot address you with the same ability that he would. He is one who helps run our city, I may say he runs the city now all by himself, and as mayor of the city he wishes to extend to you a very warm welcome. I want to say to you too, that I know our local chairman here, F. A. Bowman, a gentleman who is fairly good looking, who plays a good game of golf, is of a religious turn and a good citizen, and having Mr. Dodwell and Mr. Bowman here also it makes me feel that I know you all, and if, during your stay here, you find time to call at Government House, you will find that Mrs. Grant and myself will offer you a hearty welcome to our house."

President Vaughan thanked Lieutenant Governor Grant for his nice address of welcome and apologized for the delay. It was a pleasure and privilege to be able to meet in Halifax and to hear the papers that were to be discussed. In calling upon C. E. W. Dodwell, M.E.I.C., district engineer, Public Works Department, Halifax, to read his paper on Some Notes on Preservation of Timber for Use in Salt Water, he mentioned that it was a particular pleasure to have Mr. Dodwell, who was one of the first members of the Institute, a past vice-president and councillor, as the first to give a paper at the first Maritime Professional Meeting of The Engineering Institute of Canada. Mr. Dodwell then read his paper.

Some Notes on the Preservation of Timber for use in Salt Water.

The mummies of Egypt are striking testimony of the extreme antiquity of the art and practice of the preservation of organic bodies against decay by impregnation with, or immersion in bituminous, antiseptic or chemical substances.

Protection of timber against decay, by smearing or painting it with various substances is also very ancient, for classical writers, Herodotus, Pliny and others, tell us that statues and other structures of wood, were painted or covered with bituminous, resinous or other antiseptic or germicidal substances in order to preserve them from decay.

In modern times the exigencies of constructive engineering have called into practice a number of processes for the preservation of timber against (a) decay from natural causes inherent in all bodies of an organic or organized nature, and from the attacks of land insects, such as white ants, which in tropical countries are extremely destructive, and (b) from the attacks of marine insects on timber in salt water.

Timber wholly and constantly immersed in fresh water is practically everlasting, so far as decay is concerned, for perfectly sound piles have been taken from the bed of the Tiber and other places, after having been in mud and water for a thousand years.

To prolong the useful life of timber, both in air and in salt water, a number of modes of treatment have been devised and practised.

The rest of this paper deals exclusively with the preservation of timber exposed to the attack of insects in salt water. The whole subject is far too wide for anything approaching exhaustive treatment within the limits of one brief essay.

Timber properly treated by the creosoting process is practically immune from attack by marine insects for an indefinite period. I have no knowledge of instances to the contrary. Other processes to which reference will be made further on, while efficacious against decay and the attacks of ants and other land insects, have proved of little use against marine insects, and they have been for the most part abandoned.

I have often seen, and have samples of creosoted timber which has been attacked by the limnoria, but in my opinion they merely indicate that the oil with which it was treated has been deficient in quantity, quality, or both.

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The following is an extract from the Introduction, dated December, 1909, to a reprint of a paper read before the Institution of Civil Engineers, by Sir S. B. Boulton, in May, 1884:—

"...........the Records of the Patent Office contained lists of almost every conceivable Antiseptic suitable, or unsuitable, for the Preservation of Timber. The "Traité de la Conservation des Bois," by Maxime Poulet (Paris, 1874) gives descriptions of an astonishing variety of these proposed remedies which had turned out failures. But by 1884 all these processes had ceased to be seriously considered, except four, viz:—1. The heavy Oils of Tar, commonly called Creosote; 2. Bi-Chloride of Mercury or Corrosive Sublimate; 3. Sulphate of Copper; 4. Chloride of Zinc.

In all these four processes I have had extensive experience for Railways sleepers, both in England, in France, and in various other countries. But Creosote was rapidly, and in England almost entirely, superseding the other three, and at the present day, (1909) English Engineers use Creosote only. This, in spite of the fact that the watery solutions of the Metallic Salts, cost less than Creosote. Pasteur's Germ Theory explains the fact that Oily and Bituminous bodies, in all ages of history, have been found to be the best Antiseptics in general, and Creosote, or the heavy oil of Tar, in particular, possesses a marked superiority over the solutions of Metallic Salts as permanent Antiseptics. **Creosote is a germicide and also a germ excluder.** The heavier portions of the Creosote Oils, which are their most valuable constituents, solidify in the pores of the wood and block them up from the intrusion of Germs. It is for these reasons that Creosote has in Great Britain for years past entirely superseded the use of the three Metallic Salts above mentioned, for Timber Preserving, although all three are good Antiseptics. But their effects are not sufficiently permanent owing to their solubility by water, and their volatility."

F. A. BOWMAN, M.E.I.C.,
Chairman, Halifax Branch.

The treatment by *bi-chloride* of *mercury* or *corrosive sublimate* was patented by J. H. Kyan in 1832, hence called Kyanizing, and for some years was much in vogue in Great Britain. In dry situations it had some considerable success, but in salt water, to resist attack by marine insects it proved a failure, as have all processes employing metallic salts.

The treatment by *sulphate of copper*, which has perhaps been the most successful of all the metallic salts, as an antiseptic for timber, was patented by J. J. L. Magary in 1837. Up to a few years ago it was still used in France, to a limited extent, for sleepers and telegraph poles.

The *chloride of zinc* process, which at one time was much patronized by the British Admiralty, and was extensively used in Europe for sleepers, was patented by Sir William Burnett in 1838, hence called Burnettizing. Chloride of zinc is a powerful antiseptic, but its extreme solubility renders it unfit for the permanent preservation of wood exposed to the action of water either salt or fresh.

It is interesting to note that the dates of the above mentioned patents correspond with the early infancy of railway construction in Great Britain, when the scarcity and high cost of timber in the country pointed to the urgent need of prolonging the life of sleepers and other timbers by artificial means.

If any of the three processes briefly described above are in use to-day it is to a limited extent and for timber in air only.

ALEX. GRAY, M.E.I.C.,
Chairman, St. John Branch.

Creosote, or the *Dead Oil of Tar.*

"...........The practical introduction of the process is due to Mr. John Bethell. His now celebrated patent, which is dated July, 1838, does not mention the words "Creosote" or "Creosoting." It contains a list of no less than eighteen various substances, mixtures or solutions oleaginous, bituminous, and of metallic salts. Amongst them is mentioned a mixture consisting of coal-tar thinned with from one-third to one-half of its quantity of dead oil distilled from coal-tar. This is the origin of the so-called creosoting process. Creosote, correctly so-called, is the product of the destructive distillation of wood, and Coal Tar does not contain any of the true creosote, which has never been used for timber preserving. But a substance since called carbolic acid, or phenol, had been discovered in coal-tar; it was thought by some to be identical with the creosote of wood, hence the process came to be miscalled, after a time, the Creosoting process."

Products of the combustion of bituminous coal in closed ovens are coke, tar, ammoniacal liquors and gas.

The first or direct products from the destructive distillation of coal tar are *oils lighter than water, oils heavier than water*, and *pitch*, the last a solid black residuum constituting about 55% of the tar. The proportions of these respective substances depend on the nature of the coal. The range of temperature covering the process of distillation is from 82°C. (180°F.) to 402°C. (758°F.). The light oils which come over between 82°C. (180°F.) and 165°C. (327°F.) being extremely volatile have no part in timber preservation.

The oils which come over between 170°C. (338°F.) and 402°C. (758°F.) contain numerous substances, some liquid, some semi-solid at ordinary temperature, but probably all valuable as antiseptics; the most valuable of these in the preservation of timber is naphthalene (chemical symbol $C_{10}H_8$) because it is not only a powerful germicide and antiseptic, but also a germ excluder and a sterilizer and filler of the pores of the wood.

K. H. SMITH, A.M.E.I.C.,
Secretary-Treasurer, Halifax Branch.

The usual mode of determining the percentage of naphthalene by the inspector at the time and place of treatment is by drawing off a small sample of oil from the cylinder and putting it through a simple process of fractional distillation, wherein it is assumed, with a fairly close approximation to truth, that *half* the distillate from 205°C. (401°F.) to 210°C. (410°F.) all the distillate from 210°C. (410°F.) to 235°C. (455°F.) and *half* that between 235°C. (455°F.) and 240°C. (468°F.) is naphthalene. The distillation begins at about 170°C. (338°F.) and is stopped at about 316°C. (600°F.). The fractions that pass over between 170°C. and 205°C. are carbolic, cresylic, and a few other tar acids. Those that pass over at a temperature above 240°C. are phenanthrene, anthracene and several other heavy green oils.

For our littoral waters I consider 14 lbs. of oil sufficient, but it must be unexceptionable in quality.

The process of creosoting timber is best and most clearly and concisely described by the following:—

Suggested Specification for the Treatment of Timber With the Dead Oil of Creosote.

1. The first process shall be the steaming of the timber, if fresh cut and whether round or in square sections of 10″ x 10″ and over, with live steam at a maximum pressure of 50 lbs. per square inch, and a maximum temperature of 275°F., for a period of four to seven hours. During the whole duration of this process superheated steam shall flow through the coils at the bottom of the cylinder.

A. R. CROOKSHANK, M.E.I.C.,
Secretary-Treasurer, St. John Branch.

2. A vacuum of not less than twenty inches of mercury shall then be created in the cylinder and maintained for a period of not less than five hours, or until the exhaust from the vacuum pump shows no evidence of sap in the timber, the temperature in the cylinder during this process being not less than 212°F.

3. After withdrawing from the cylinder the whole of the sap and the liquified gums and resins, it will then be filled to the top of the dome with the dead oil of creosote of approved quality, but containing not less than 40% of naphthalene, and a pressure of 45 to 120 lbs. per square inch, applied until the gauge on the supply cylinder

indicates that the specified quantity of oil has been absorbed by the timber.

4. Every piece of timber shall be bored with a ½ inch auger by the inspector, but at the expense of the creosoting company, to ascertain the depth of oil-penetration, which for a specified 12 lbs. per cubic foot shall be not less than 3 inches; for 14 lbs. not less than 3½ inches, for 16 lbs., 4 inches, and for 20 lbs. 4½ inches. The borings shall be tested by the inspector to make sure that the discoloration is due to oil of proper quality and not to adulterants.

5. At least one sample of oil shall be drawn from each cylinder charge and analysed by fractional distillation by the inspector, and every sample so analysed shall contain not less than 40% of naphthalene.

The oil must be completely liquid at 110°F. and it must contain not less than 25% of constituents that distil above 600°F.

6. The creosoting company shall carry out the instructions of the inspector as to the duration and all other details of the several processes of treatment.

Naturally the details of the above process must be slightly varied to suit the differing conditions of the timber, its sizes, length of time since it left the stump, season of the year at which it was felled, and its kind.

The inspector, therefore, must be a trustworthy man of judgment and experience and he must have latitude and discretionary power to adapt the several stages of the treatment to the attainment of the desired results.

The above specification is specially designed for the treatment of the Loblolly Pine, alias Old Field Pine, of which the botanical name is *Pinus Taeda.* It grows mainly in Virginia and North Carolina and is the only kind of timber that I have used creosoted. This has been mainly because it is the only kind of timber that, at the same time takes creosote readily and is to be had in large quantities, and in long lengths, at no great distance from the creosoting works in Norfolk, from which I have obtained nearly all the creosoted timber that I have used. As a structural timber it is inferior, as regards resistance to transverse and compressive stress, to other pines, or to our maritime spruce, but owing to its open, straight grain, it is conspicuously adapted for impregnation, and for piling it can be had in lengths up to 80 or even 85 feet, straight, with few knots and little taper.

Long Leaf or Georgia Pine (Pinus Palustris), the Yellow or Short Leaf Pine (Pinus Echinata) and Pitch Pine (Pinus Rigida) of the Southern States, are superior timbers, but being denser in fibre and containing much gum and resin, are not receptive of creosote and are rarely treated. Our own White Pine (Pinus Strobus) is an excellent timber of the so-called soft varieties of pine, and would probably take from 10 to 12 pounds of oil with moderate vacuum and pressure, but it is now too valuable as finishing lumber and its cost for purchase, treatment and transportation would be prohibitive.

Our own hemlock and hardwood, beech, birch, maple and oak, do not readily take creosote, owing to their density of structure, and I have no knowledge of their having undergone treatment, except experimentally.

Some seven or eight years ago the Dominion Tar and Chemical Company of Sydney, N.S., established a small creosoting plant, at which their chief or exclusive business is the treatment of ties and cross-arms for the C. P. Ry., and the manager, L. O. P. Walsh, tells me that he has succeeded in getting from 10 to 12 pounds of oil into beech, maple and birch. These works, with another plant on the same scale at Winnipeg, are, so far as I am aware, the only creosoting works in Canada.

The Federal Government of Canada has several times in the past 15 or 20 years taken into consideration the advisability of establishing their own creosoting works (at a probable cost of $100,000 to $150,000) for the treatment of timber intended for use in Government works, and more than once an appropriation has been noted in the estimates for this purpose, but up to the present time nothing has been done, owing to various causes, political and other. One difficulty has been in the choice of a site. A creosoting plant should be placed (a) near the source of timber, (b) conveniently as regards transportation, both by land and water, and (c) as near as possible to the works in which the timber is to be used. Needless to say it is difficult, indeed impracticable, to fulfil all these conditions in one site.

Another difficulty has been the prevalent idea that our Canadian timbers are not adapted for impregnation by creosote. Some years ago the late P. S. Archibald, Chief Engineer of the I.C.R., sent a number of samples of Canadian woods to creosoting concerns in the United States, but they, perhaps for business reasons, reported that the timbers refused to take a sufficient quantity of oil to render them immune from attack by marine insects. Of this, however, I have had grave doubts, which have been in a large measure confirmed by the experiments carried on at the works of the Dominion Tar and Chemical Company at Sydney.

In the United States several of the principal railway companies have their own creosoting plants for treating ties, poles, cross-arms, etc.

The cost, to purchaser, of the process of creosoting timber is, or was before the war, about $1.00 per pound of oil, per thousand feet b.m. of timber, i.e., for 14 pound treatment $14.00 per M. feet B.M. must be added to the cost of the timber and its transportation to and from the creosoting plant.

In 1908 we paid $60.00 per M. for 200 M. of 8″ x 10″ Loblolly pine, less than 20 feet long, and $65.00 per M. for 20 feet to 39 feet long, treated with 14 pounds of oil and *delivered* at Annapolis. In 1912 we paid $54.75 per M. for 520 M. feet of 10″ x 12″ Loblolly Pine from 15 to 30 feet long, treated with 14 pounds of oil per cubic foot and *delivered* at Trout Cove, Digby County, N.S. In 1908, a small lot of about ten thousand feet cost $74.50 per M. *delivered* at Chatham, N.B. Treated piles cost from 50 cents to 65 cents per running foot for a 14 pound treatment, depending chiefly on lengths. The price of course depends as much on transportation charges as it does on the quantity of oil, and for a less quantity than a small schooner load of about 100 M. feet the delivered price would be high. Timber treated with 14 pounds of oil weighs from 60 to 65 pounds per cubic foot i.e., from 370 to 400 feet B.M. weigh one ton of

2,000 pounds. Inspection at the works including oil analyses, costs generally 60 cents per hundred lineal feet of round timber, and 50 cents per M. feet B.M. of squared. I have no information whatever as to the cost of creosoted timber at the present time. As a matter of fact it is practically unobtainable.

Surface Treatment—Several modes of treating the exterior of timber, exposed to attack by marine insects, have been tried with varied success. Covering with sheet metal, copper or muntz metal, is an effectual protection against the teredo or limnoria, but for timber partly in and partly out of water it does not prevent decay in the above water portion, and it is of no use for timbers exposed to abrasion by vessels or the wash and wear of sand and gravel under the action of waves. Some years ago I sheathed part of the side and end of a breakwater with second-hand muntz metal, against the limnoria, but the sand and gravel thrown against the sheathing by the waves wore it out within less than two years. Muntz metal, an alloy of 6 parts copper and 4 parts zinc, is the cheapest effectual metallic sheathing in salt water, and it is universally used for the bottom of wooden ships. Its market price before the war was about 15½ cents per pound, or say, 17 cents per square foot for the thickness generally used. A creosoted pile, 50 feet long, would cost about $30.00. The same length of pile uncreosoted, but with 35 feet of its length sheathed with muntz metal (the upper 6 feet above water and the lower (say) 10 feet under ground being left bare) would cost approximately $7.00 for the timber and $27.00 for the sheathing, including metal, nails and labour, a total of $34.00, or $4.00 more than the cost of a creosoted pile, and the latter would last indefinitely longer. Note that all these costs and prices are as before the war. What they may be to-day, who knows?

Another style of sheathing for piles is called, by its exploiters, the *P. and B. Teredo Proof Pile Covering.* It has been used to some extent and with a claimed success on the Pacific coast, but, notwithstanding the claim made for it, I have doubts as to its economy. I have no data as to its cost, but it would surely be more expensive than the metallic sheathing mentioned above.

Of patent antiseptic fluids "dopes" and nostrums, for the preservation of timber by painting or immersion, there is no end. Few of them make any direct or serious claim to efficacy against attack by marine insects in salt water, though some of them do so by implication. All of them, however, have the most wonderful properties and by the mere slap of a brush confer immortality on timber, under all conditions of exposure and wear; at least after a perusal of their advertisements and testimonials an open mind can not come to a conclusion short of this. My own opinion is, that, were it possible to conduct a series of the most elaborate and exhaustive experiments and trials, extending over a period of many years, it would be found that most of them are not worth their cost to purchase and apply, except under peculiarly favourable conditions and circumstances such as their thorough and repeated application to well seasoned timber of small dimension, little or not at all exposed to weather.

Prominent among these fluids is Carbolineum Avenarius, a German production, probably, and judging from its constitution, simply the dead oil of creosote, with the more valuable constituents removed. The following is an analysis of it that I had made in 1904:—

Light volatile oils	Benzine series	3.23%
Light creosote oils	Naphthaline series distilling at or below 321°C. (610°F.)	16.81
Heavy creosote oils,	Anthracene series fixed at 321°C.	79.96
		100.00
Naphthaline in distillate, calculated to % of Carbolineum Avenarius		1.02
Tar acids in distillate, calculated to % of Carbolineum Avenarius		2.10
Specific gravity		1.124

Of this stuff I have used several thousand gallons in the last twenty years, but I have seen no reason as yet to change the general opinion of it that I formed when I began to use it.

In 1905 we built a large pier at Port Wade, on the Annapolis Basin, at a cost of about $100,000, and thereon I used some 1500 or 1600 gallons in treating flooring, stringers, caps and guard timbers. The stringers and other large dimension timber are of southern pine and still sound, but would have been so untreated. A portion of the flooring, which was of spruce, 6 inches thick, was treated with hot Carbolineum Avenarius, applied with brushes. A careful examination at this date would fail to detect any difference between the treated and the untreated, all of it being more or less decayed. Some of the 12″ x 14″ guard timbers I boiled in Carbolineum Avenarius for one to three hours, but to-day there is nothing in their appearance or condition to differentiate them from contiguous timbers untreated. This precious stuff cost the department $1.00 per gallon plus freight. To apply it costs from 30 cents to 75 cents per gallon.If we could buy it for 5 to 10 cents per gallon, and apply it for about the same, it might possibly be worth while, but it is certainly not worth more than 10 cents on the dollar of its actual cost.

In a letter that I received in June, 1914, from the president of the Carbolineum Wood Preserving Co. of New York, he makes the following extraordinary claims,

"Tested under equal conditions by the U. S. Forest Service Avenarius Carbolineum is,

More fireproof than creosote

Increases the strength of wood while creosote decreases it.

Is permanent while creosote is volatile.

Is a better insulator and has greater penetrating powers than creosote."

On these preposterous claims comment is hardly necessary.

Among other so-called wood preservatives may be mentioned *Carbolite Carbolineum,* probably an imitation of Carbolineum Avenarius.

Solignum,—An English preparation with no special claims, beyond general excellence for its designed purpose.

Spirritine,—(of the Creosoting Works, Willmington, N.C.) said to consist of 50% wood creosote and 50% neutral oils, *insoluble in wood* (sic.) and claimed to be

" as a preserver equal . . . . to any of the coal tar preparations, by a test of 25 years " and " in comparison with creosote, less expensive, with same results so far as it has been tested, alongside creosote." The last (underlined) words are a prudent saving clause.

One of the most impudent is "*Teredo-Proof* and *Wood-Armour Paint*", an American production, claimed to be a " Germicidal Chemical Compound ", a " peerless wood preservative ", and " *an absolute protection against teredo.*" I should say that the last claim damns them all.

My ideas in regard to the above nostrums, et hoc genus omne, is briefly:—that they cost ten times as much as oil of creosote. That even if they were injected into timber as is done with creosote, they would be of little or no use as preventive of marine insect attack, and that the painting or immersion of timber in hot creosote, costing from 8 to 10 cents per gallon, would be of greater efficacy than similar treatment with any of them, though of but little lasting value.

It is not good business to spend a dollar in adding 10 cents to the value of a piece of timber.

Finally, the preservation of timber, especially for use in salt water, depends upon (a) sterilization; (b) impregnation to a depth of at least two or three inches, with a powerful antiseptic germicide and germ excluder.

Impregnation to a greater depth than about the sixteenth part of an inch cannot be obtained by painting, soaking or boiling timber in so-called preservatives, and by this mode of treatment there is no sterilization whatever.

At the conclusion of the reading of this paper, the President declared the meeting open for discussion, mentioning that it struck him as being strange that while attending the meeting at Saskatoon he listened with a great deal of interest to the discussion of the action of alkali water on concrete and now at this meeting we were hearing of the problems which engineers had to face where timber was exposed to salt water.

A. F. Dyer, A.M.E.I.C., showed the meeting a piece of wood illustrating the work of a small type of teredo, being about 2″ long and no thicker than a slate pencil. The same piles from which this wood came had been attacked by limnoria to a depth of about ½″, this wood having been bought in 1909.

C. C. Kirby, A.M.E.I.C., asked Mr. Dodwell if he had any theory to account for the fact that St. John was practically immune from attacks of the teredo and limnoria, surmising that it was due to the amount of fresh water. In this Mr. Dodwell concurred. New York harbour did not suffer from the teredo on account of the amount of sewer water. Halifax harbour suffers both from the teredo and the limnoria, the teredo particularly being destructive, making the life of untreated timber about six months. Nearly every wharf in Halifax is eaten by one or other of these.

K. H. Smith, A.M.E.I.C., gave information to the effect that there has recently been established a station on the banks of the St. John river where records are obtained of the fresh water flow into the harbour.

In response to a question from the President, Mr. Dodwell stated that as far as his experience went, timber properly treated with the proper quality and quantity of oil was immune for an indefinite period and treated timber when attacked showed that either the quantity or quality was not up to specification. To maintain the quality requires proper inspection. He did not know of any instances of properly treated timber being attacked but even the best treated timber is not immune forever as the action of waves eventually washes out a quantity of oil. He found that 40 percent naphthaline is the best disinfectant and preventive against the action of waves and the operation of insects.

Economic Aspects of the Halifax Ocean Terminals

was the next paper on the programme, being read by the author, G. A. MacLeod, in which he pointed out the relationship between the subject, considered from an engineering standpoint and from a commercial and business standpoint. At the beginning he referred to the fact that contractors are more and more employing engineers as part of their organization and, inasmuch as many of the young members of the profession would undoubtedly cast in their lot with contracting firms, he called particular attention to the necessity of learning business principles and of understanding the close relationship between business and engineering, in order to get a thorough grasp of the sense of values and to consider an investment from the view point of its earning capacity. It is thus that business is created, by making it earn a sum that establishes for it a value much more than the actual monetary cost.

In discussing the Halifax Ocean Terminals now under construction, it was necessary to consider the actual expenditure, which will be at least $15,000,000. The question was: Can they be made to repay that and a return on the investment as well, and was it intended that they should? He believed that they could and would do so.

In continuing, he went into some of the features of the construction and layout of the terminals from the view point of their ability for taking care of business. When the terminals were completed it would be necessary, as in all business concerns, to operate them to their capacity. He believed that it was impossible to handle the volume of business over the single track from Moncton and this feature of the construction was no doubt one which was being given consideration both by the engineering profession and by the authorities.

In the discussion which followed, it was pointed out that the estimate of $15,000,000 was for work now contracted for and that the estimate of the whole scheme was $30,000,000 which was a pre war figure.

At the conclusion of the discussion, the President thanked Mr. MacLeod for attending the meeting and presenting his paper, and asked F. A. Bowman, M.E.I.C., chairman of the Halifax Branch, to explain the changes which had been made in the programme. It was decided to transpose the fourth session to the afternoon of the first day and have the paper on Town Planning read on Thursday morning.

Luncheon at the Green Lantern

The morning session being brought to a close, the members gathered for luncheon at the Green Lantern Cafe to the number of about fifty, at which the Chairman of the Halifax Branch presided. President Vaughan gave an address on the need of organization and the requirements of a good society which was appreciated by those present. The occasion was further graced by the attendance of Past President Dr. Martin Murphy who was for a number of years a Member of Council, a charter member of the organization and is one of the oldest living members of the profession. Dr. Murphy favored those present with a few remarks. The Secretary also gave a brief address on the recent development of the Institute and the possibilities for the future.

Second Session

3 p.m., Wednesday, September 11th.

The meeting was opened by A. F. Dyer, A.M.E.I.C., who read his paper on The Use of Reinforced Concrete Construction in Harbour Work.

The Use of Reinforced Concrete Construction in Harbour Work.

Mass concrete has been used in the development of harbours for practically as long a time as it has been used on land, but the use of comparatively light concrete structures, reinforced with steel embedded in them, only commenced with the present century, and there are few, if any, reinforced concrete marine structures of a greater age than fifteen years. In that short time, however, it has been used extensively in every continent and in every harbour and port of importance.

At first harbour engineers went ahead and used this new form of construction with apparently little or no fears for the future, but of late years their eyes have been somewhat rudely opened and now it is being realized, more and more every year, that successful use of reinforced concrete in marine works depends not only on very careful designing and the first class quality of the workmanship, which means a most rigid inspection of the materials and work, but also on the means taken to protect the structure against the elements and other harmful agents.

R. J. Wig of the U. S. Bureau of Standards and L. R. Ferguson of the Portland Cement Association have recently made a very extensive examination into the condition of nearly every important marine concrete structure in the United States and Canada. The results of their investigations were published in Vol. 79 of Engineering-News-Record and are well worthy of careful study.

In their report they state that " the majority of all reinforced concrete marine structures on the American Coasts, subjected to sea-water action, are now showing evidences of deterioration or failure due to the corrosion of the embedded reinforcement above the water line".

That is a very serious and important statement. The structures reported on were, in practically all cases, less than ten years old at the time of their examination, many of them had been but recently completed. It means that in the majority of cases in America the use of reinforced concrete in marine structures has not been an unqualified success up to the present time, and it adds that the cause of the failure is ' the corrosion of the embedded reinforcement above the water line.'

These gentlemen further state that their investigations led them to believe that reinforced concrete of excellent quality, designed according to recommendations of engineering societies and present day practice, is subject to relatively rapid deterioration in most localities. They found however that below low water level reinforced concrete appeared to be safe.

Other investigators have found similar conditions in other parts of the world. S. H. Ellis, M.Inst.C.E. in a paper published in Vol. 199 of the Minutes of Proceedings of the Institution of Civil Engineers, describes finding much corrosion taking place in a steel and concrete wharf in Hong Kong Harbour. The wharf was a structural

Swinging Concrete Pile

steel wharf encased in 1:2:4 concrete. Four years after the wharf was built it was found that the steel was badly corroded above high water mark, even where protected with 2½ inches of concrete. 3/16" round lacing was practically corroded away. Below mean tide level no signs of corrosion were found. A reinforced concrete lighthouse, built in the Malacca Straits in 1908, in which the steel had a covering of from 1½ to 2½ inches of concrete, was found in 1914 to be so much corroded from low water of neap tides to 85 feet above high water of spring tides that extensive repairs had to be carried out. The corrosion in this case may have been helped by vibration caused by wind and wave action as the structure is reported to have been rather light.

Mr. Ellis also mentioned several reinforced concrete, wharves which he had examined in the East, all of which showed more or less corrosive action taking place above high water level. In one case so bad was the corrosion that the concrete had flaked off the underside of the deck beams leaving the tension steel entirely exposed.

The disintegration or disruption of the concrete above high water level is apparently due to the absorption by

the concrete of salt water carried in suspension in the air which moisture eventually finds its way to the steel and causes the corrosion. High temperatures are favourable to this action. To prevent, or at least retard this action taking place, it is necessary to have the reinforcing steel covered by an ample thickness of concrete of maximum density which means generous designing in the size of members, securely tying the reinforcing steel in its proper place before the concrete is poured so that it will not be

Tipping Steel Cylinder into Water

pushed aside by the liquid concrete but be properly embedded where intended, the careful selection of materials and possibly the painting of all concrete surfaces above high water mark with waterproof paint.

In some cases failure of reinforced concrete structures has taken place between low and high water levels before any signs of disintegration appeared above high water. In cold climates this type of failure is usually due to the mechanical action of frost freezing the water absorbed by the concrete and thus bursting the outer skin of concrete, aided by the abrasion of the concrete by floating ice and the chemical action of the sea-water on the interior concrete. This chemical action is particularly severe on concrete from which the outer surface has been removed by frost or other means even when the temperature is low. In certain cases, however, failure between tides has been due to the fact that low water brace members were introduced which necessitated the pouring of the concrete above that level ' in situ '. Concrete which is allowed to come in contact with sea-water while setting does not have the same power of resistance against the chemical action of the water as concrete which has matured on shore, and therefore, as far as possible, precast members should be used to at least extreme high water level.

The mechanical action of frost and ice may be prevented by protecting the concrete surfaces between tides with timber sheathing. Concrete bridge piers in this country which have been so protected have been found in perfect condition under the planking after 25 years service.

It will thus be seen that the use of reinforced concrete in marine works is attended by some risk and that protective measures must be taken to preserve its life. This does not mean that reinforced concrete should not be used for harbour works any more than that structural steel should not be used for making bridges. Both are vulnerable but both can be protected.

It may now be of interest to consider for a few minutes some of the uses to which reinforced concrete has been put in various harbours. The following descriptions have been derived from articles and papers published in technical journals and proceedings of technical societies with the exception of the works in Halifax with which the author was connected.

One of the first uses made of reinforced concrete was in the manufacture of concrete piles to take the place of timber piles which are so vulnerable to the ravages of the teredo and limnoria. The first piles made were, as a rule, comparatively small, being not more than 12 inches round or square, and their life in consequence did not prove long.

When in England in 1914 the author was informed by one of the foremost concrete engineers in London that he had just completed the rebuilding of the majority of the concrete piles from low water level up which supported a reinforced concrete pier built in 1903. Reinforced concrete piles are still being used in English ports, large numbers of 14″ and 16″ piles having been used in the improvement works of the port of London since 1911, but the tendency there of late years has been to drive the piles in groups of two, three, four or more piles which are enclosed in reinforced concrete cylinders sunk to a level below dock bottom and filled solid with concrete. These cylinders reach to high water level and support the posts and braces carrying the pier deck.

Conveying Steel Cylinder to its Position

A jetty built recently at Tilbury Docks, London is 1000 feet long by 50 feet wide and is supported on three longitudinal rows of such cylinder piers. The centre row cylinders are 7′–6″ in diameter containing eight piles while the outer rows are of 5′–6″ diameter cylinders with four piles in each.

In Senegal, French West Africa, previous to the war nearly 4,000 lineal feet of reinforced concrete pile wharves

were built entirely by the native African labour under the supervision of a few French engineers. The piles used were 13″ and 16″ octagonal spaced 13 feet and 16 feet apart and carrying a reinforced concrete deck of beam and slab construction. Salt water was used in mixing the concrete for this work, which practice is not one to be recommended in reinforced concrete work.

In a paper read before the Institution of Civil Engineers and published in Vol. 188 of the Proceedings,

Pile Reinforcement

S. H. Ellis describes the construction of a reinforced concrete wharf 1,160 feet long by 174 feet wide at Lower Pootung, Shanghai. The bottom there consists of mud to a depth of over 400 feet, the top 25 feet of this as a rule forming a fairly solid crust of stiff sandy clay which has to be depended on for carrying loads.

The piles used are 14″ square driven in groups of four, 15 feet centre to centre of groups. The heads of the piles were cut down to a level between low and high water and there capped with a concrete cap and braced with a system of precast longitudinal and transverse beams. The pier deck, of reinforced concrete beam and slab construction, is supported on 15″ square columns resting on the pile caps. Diagonal bracing is introduced between the pile caps and the deck.

The piles were driven by a single acting steam hammer operating a weight of 7,800 lbs. dropping 6″ to 8″. A final set of 1″ per blow was usually obtained which was found by tests to have sufficient resistance to carry the designed load of about 25,000 lbs, per pile without appreciable settlement. Further driving of the piles into the soft mud below decreased their resistance. The water at Lower Pootung is fresh and after three years no rust, stains nor cracks were visible on the pile heads or superstructure.

At Los Angeles reinforced concrete piles have been used to support a timber floor pier. The piles are 20″ square at their bases tapering to 14″ and 17″ at their tops. They were not driven, but a hole having been jetted into the hard sandy clay bottom the piles was set in the hole base downwards and then consolidated by several blows from a 4500 lbs. hammer. As a contrast to this may be mentioned the practice in New York Harbour, where neither the teredo nor the limnoria is to be found, of using timber piles to support a reinforced concrete deck and structural steel shed.

Reinforced concrete sheet piles to form low retaining walls have been extensively used in various ports. One form of pile wall has been described by Sir Francis Spring, M.Inst.C.E. The walls were built in Madras Harbour and consisted of 15″ and 18″ square reinforced concrete piles driven by water jet at 8 to 10 feet centres, depending upon conditions, and anchored back by steel ties. Reinforced concrete slabs varying in thickness from 6″ to 15″ were placed at the back of the piles, the lowest slab having a chisel shaped edge and being sunk into the sand bottom. The height of these walls varied from 10 to 16 feet above dock bottom.

The use of reinforced concrete cylinder piers was first started at San Francisco about 1906 when two shipping piers each 686 feet long by 130 feet wide were commenced. The cylinders are 3′ 6″ in diameter spaced 13′ 4″ apart transversely and 15′ longitudinally. They were formed by sinking to hard bottom circular wooden forms built strong enough to withstand driving and the water pressure when emptied. All soft mud and water were then removed from inside the forms before they were filled with concrete. Each cylinder is reinforced with eight 1″ square bars hooped at 9″ centres with ¾″ by ⅛″ bands. The decks are of structural steel I beams and concrete. Later piers built at San Francisco are of the same type but with all reinforced concrete decks.

At Valparaiso a coaling pier 655 feet long by 98 feet wide has been lately completed. This pier is supported

Interior of Concrete Shed

on 76 reinforced concrete cylinders 13 feet in diameter and varying from 46 to 82 feet in length. In this case the forms were made of reinforced concrete in sections from 6′ 6″ to 13′ high having a shell thickness of 8″. The bottom section of each cylinder is proved with a cast iron cutting edge and into each section are moulded cast iron jointing rings for the purpose of bolting the sections together. The sections, after seasoning, were built up

and bolted together inside a steel tower supported on pile staging and fitted with hydraulic gear so that when sufficient length to come above the water level had been bolted together the cylinder could be lowered to sea bottom. The cylinder was then sunk to the required depth by excavating inside and weighting, further sections being bolted on as it went down. Eight reinforced concrete piles were then driven inside each cylinder after which the cylinders were filled with concrete, the lower portion of which was put in under water to form a seal and the remainder was put in after the water had been pumped out of the cylinder. The heads of the cylinders were then joined by a transverse girder of reinforced concrete cast in place on which rested a deck system of precast beams and slabs.

Reinforced concrete retaining walls of different types have been much used. When properly designed these are very suitable in places where stable foundations are not easily obtained and where no great depth of water alongside the wall is desired.

At Lower Pootung, where the deep mud foundations exist, a retaining wall 495 feet long and with a height of 21′ 6″ above dock bottom was built in the following manner: Cross rows of three 12″ square piles were driven, the front piles of which serve as king piles to a continuous line of concrete sheet piles which in turn form the face of the wall up to a height of 12 feet below quay level. At that level the heads of all the piles are connected together by a reinforced concrete platform supporting a nearly vertical slab tied back to the deck by counterforts seven feet apart. Anchor ties were found to be necessary and were put in at 20 centres being carried back to the foundations of a shed alongside the wall.

In Australian ports a type of precast wall called a reinforced concrete trestle wall has been used for some years with apparently good results. They are formed with precast L shaped buttresses which are set at regular intervals on a prepared level foundation. These buttresses are flanged to hold precast reinforced concrete slabs which fill in the spaces between the buttresses. This type of wall has been used up to 27 feet in height and the advantages claimed for it are economy, stability on bad foundations, flexibility where settlement occurs in the foundations, rapidity of erection and greater resistance to the chemical action of sea water as all its parts are seasoned on shore.

The ordinary type of reinforced concrete retaining wall having inside buttresses and vertical and horizontal slabs all cast in place was used in the construction of a pier at Padstow, Cornwall, England, which is 800 feet in length by 40 feet wide and which carries two railway tracks. The rise and fall of the tide at Padstow is about 20 feet. The foundation slab consists of mass concrete resting on solid rock and it varies from 3 to 9 feet in thickness in order that it might be finished 12″ above low water of spring tides. The height of the vertical wall is 23′ 6″. Cross ties connect the two side walls at intervals, and the space enclosed by the walls was filled in with earth &c. It will be interesting to know how long this structure will last, as its location is a very exposed one.

Reinforced concrete cribs or caissons have been used for a number of years both in Europe and America in the construction of quay walls and breakwaters. At Norresundby Harbour, Denmark, concrete caissons 32′ 6″ long, 8′ 4″ wide, 25 feet high and with a thickness of wall of only 5.1″ at their base and 3.5″ at their tops, were built on shore and launched sideways into the harbour. No failures from cracking during launching occurred but the wall thickness appears to be too light for permanent marine work.

At Copenhagen a quay wall 3300 feet in length has been constructed using reinforced concrete cribs of an average length of 162 feet each. These cribs are 32 feet in height by 16 feet wide but with their bottom slab spread to a total width of 23 feet. The front and back walls average 10½″ in thickness and are stiffened by cross beams and struts. These cribs were filled with

Setting Steel Cylinder

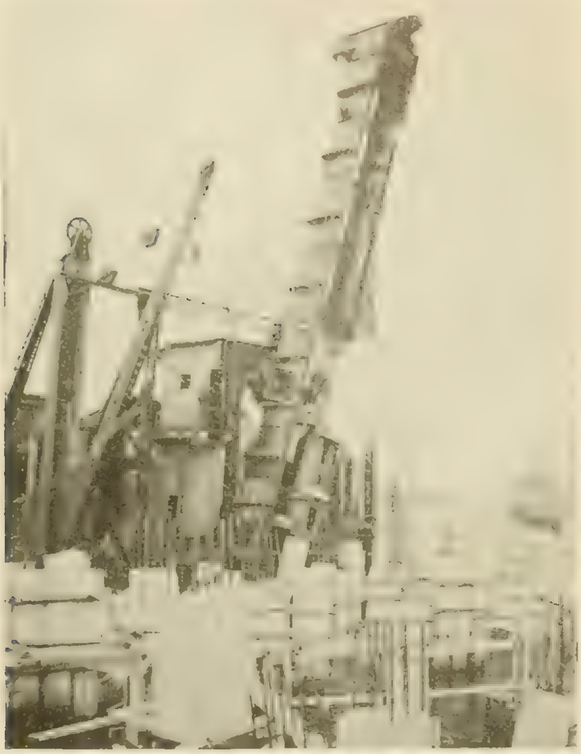
sand and capped with a granite faced wall 7 feet in height projecting 13½″ beyond the face of the crib below. The granite facing is carried down 4′ 3″ below the top of the crib for which purpose the front wall of the crib was recessed. These cribs were built in a temporary drydock large enough to accommodate three at one time and the concrete used in their construction was mixed in the proportions of 1: 2: 3.

Some large reinforced concrete cribs have been lately used at Victoria, B. C. These averaged 80 feet long, 35 feet wide, 39 feet high and 2500 tons launching weight. They were built on a timber pile skeleton wharf and launched on a cradle down a slipway situated at one end of the wharf. Five construction platforms mounted on rollers were used. When a crib was launched the remain-

ing four cribs on the wharf were pulled along one space and the empty platform taken from the crib just launched was towed to the far end of the wharf and pulled up on the tracks by means of a short incline ready to receive the forms and reinforcement for another crib.

At Valparaiso, reinforced concrete monoliths 66 feet long, 53 feet wide, 50 feet high and with a launching weight of 2300 tons were used in the construction of a breakwater.

Lighthouses, in different countries, have been built either in part or wholly of reinforced concrete which material is especially suitable for such works when properly protected.



Driving Batter Pile

Reinforced concrete has not yet entered the field of drydock construction to any great extent. Several docks lately built have their walls or floors reinforced in part but they are really mass concrete docks into which reinforcing steel has been introduced to take care of some probable tensile stresses. The author is not aware of any drydock with reinforced concrete walls and floor in the usually accepted meaning of the term but there is no doubt that such a dock can be and will be built with advantage in due time.

In Halifax harbour, since 1912, there have been used three types of reinforced concrete construction. The reinforced concrete pile wharf is exemplified by pier No. 2, the concrete cylinder wharf by the Furness-Withy pier and a new type of reinforced concrete hollow block wall has been successfully used at the Halifax Ocean Terminals. This last type of construction has been fully and interestingly described by A. C. Brown, A. M. E. I. C., resident engineer on the Halifax Ocean Terminals, in a paper read before the Canadian Society of Civil Engineers at Montreal in April of last year.

Halifax Ocean Terminals. — These hollow cellular blocks are 21′-10″ on face, 31 feet from back to front and 4′-1-½″ high. They have reinforced concrete walls 8″ thick and are divided by internal partitions into twelve cells or compartments. A standard block weighs 62-½ tons and is reinforced with 1.49 per cent of steel. These blocks are set on a prepared foundation and built one on top of another to the required height. The three front compartments and the centre compartments running from front to back are filled with concrete. The remaining compartments are filled with concrete up to the centre of the second block above the foundations, the balance being filled with dredged rock.

At a level of one foot below low water of spring tides the blocks are reduced in depth, being set back 4′-8″ from the face to allow of the building of a granite faced concrete coping wall.

In this type of construction no concrete, plain or reinforced, is exposed above low water level.

The construction of pier No. 2 was described by the author in a paper read before the Nova Scocia Society of Engineers in December 1914 but it may not be out of place here to mention some of its chief features.

The length of the structure is 800 feet, its width 235 feet and the depth of water alongside varies from 34 feet to 57 feet below low water of spring tides.

All the piles used are 24″ square in cross section, reinforced with eight round rods of size varying from 1″ to 1-¼″ in diameter according to the length of the pile, The lengths of the piles ranged from 47 feet to 77 feet and a total of 1801 piles were used.

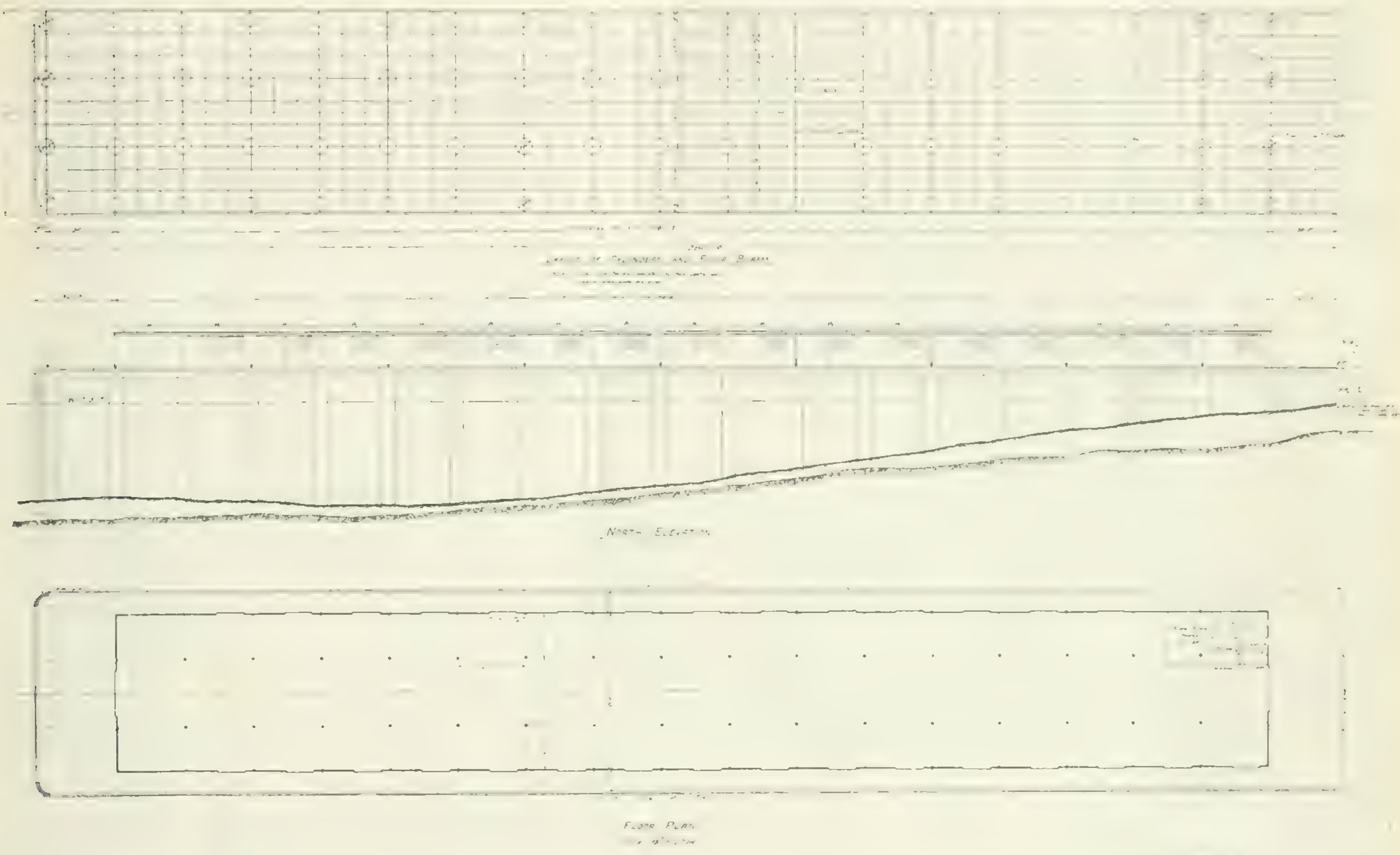
These piles were cast at the contractor's yard seven miles from the site of the pier and were made of concrete mixed approximately in the proportion of 1: 1-½: 3, the cement containing not more than 6.5 per cent of alumina. The alumina content was kept low so as to lessen the chemical action of sea water on the concrete, it being generally held at that time that the magnesium sulphate contained in sea water attacked cements high in alumina much more readily than those having a low percentage. It is interesting to note here that Messrs Wig and Ferguson in their report, mentioned above, state that the percentage of alumina in the cement appears to have no effect on the concrete's durability in sea water.

At all times an endeavour was made to procure as dense a concrete as possible. The reinforcement of the piles was designed to take care of the bending stresses when they were being lifted in a horizontal position. In order to keep these stresses at a minimum it was specified that the pile should only be lifted at points one fifth of their length from each end. No piles were cracked while being properly handled. The few piles that were cracked by accidents were discarded. The piles were cast in pairs and the concreting of a pair once started was continued without interruption until completed.

Three feet of the reinforcing rods were allowed to project out of the head of the pile for bonding into the superstructure. No shoes were used on the pile points, the concrete, heavily reinforced, being formed to a blunt point.

As a pier with vertical piles only has small lateral stiffness bracing piles were driven at an angle of one horizontal to three vertical, and, in order to increase the stiffness of these raking piles they were cast with sufficient camber that when driven and built into the pier with their convex side upwards and under an axial load of 80 tons, the stresses on the cross section of the concrete due to this load plus the bending moment stresses due to the weight of the pile, would be uniform. The amount of camber required varied from 2″ in a 45 foot pile to 5½″ in a pile 75 feet long.

Each bent consists of 33 vertical piles and six brace piles, three of which latter lean towards the north side and three towards the south side of the pier. The vertical piles are driven singly and in groups according to the concentration of the loads from the superstructure, and the brace piles are driven in such positions that their heads were built up along with the group of piles under each shed column. The bents were driven 18 feet centre to centre. The total number of brace piles used in the work is 238.



As the piles ranged from 12 to 23 tons in weight special pile driving apparatus had to be built to handle them. This apparatus was placed on a strongly built wooden scow 112 feet long overall by 56 feet wide over spud leads and 12 feet deep at the bow.

The drums and machinery for handling the piles in the leads and operating the hammer are supported on a heavy structural steel carriage, mounted on rollers which travel on a track, and the whole is moved by means of a rack and pinion drive. The front of the carriage is provided with two heavy girders. The upper girder carries a trunnion bearing which supports the weight of the leads, while on the lower girder is a specially designed crosshead attached to the leads in such a way that they are held firmly. Trunnion bearing and crosshead are connected to independent screw shafts driven by an engine; hence simultaneous operation of both shafts will move the leads laterally across the carriage, while operation of either shaft alone will cant them. In this way a transverse motion of eight feet as well as a fore and aft play of seven feet is provided and canting of the leads to take care of the brace piles is also made possible.

Two forward spuds and one stern spud, each provided with an independent engine hold the driver in position when in action, These spud engines are

controlled by the engineer in his position in the travelling leads carriage by means of levers. The pile hammer used was a double acting steam hammer made by the Union Iron Works of Hoboken, N.J. The combined weight of hammer, follower and follower guide is about 16 tons. The cylinder has a diameter of 14″ and a stroke of 36″ The weight of the piston and ram is 4,150 lbs. With a mean effective steam pressure of 80 lbs. per square inch in the cylinder the hammer is rated to develope 3,916,000 foot lbs. per minute when the hammer is striking 80 blows per minute.

Owing to the fact that this was the largest hammer of its kind ever built, considerable trouble was experienced at first in its use, and it was not until June 1913 that the last of the hammer difficulties were overcome and the driving of the piles could be proceeded with without interruption by serious breakdowns of the hammer.

Two 30 ton derricks were placed at the forward corners of the scow for handling the piles to the leads from the scows on which they were brought up to the work.

Three separate cushions were used between the concrete and the ram of the hammer. On top of the pile was placed 3″ of spruce planking on which rested a cast steel follower about four feet high consisting of a hollow cylinder with top and bottom flanges, the bottom flange having eight holes through which the rods projecting from pile head passed. The top flange had formed on its upper side a rectangular depression in which was placed a hardwood block about 15″ thick bound round with a heavy steel band. This block received the direct blows of the hammer and had to be frequently renewed.

The materials through which the piles were driven consisted of from 5 to 27 feet of soft mud and from 2 to 12 feet of hard clay, gravel and stones overlying the rock. The weight of the pile and hammer was sufficient to penetrate the soft mud while from 200 to 1,800 blows were required to drive the pile to refusal. Although the driving was very hard, the last few inches of penetration being at the rate of one inch to 30 or 40 blows, the pile heads suffered practically no damage. Nine piles, at various times, were pulled up after having been driven and on examination were found to have suffered no material damage either at their points or any part of their length. Test loads of from 90 to 120 tons were applied to individual piles with no resultant settlement where the pile had been driven to refusal.

The piles, after being driven, were extended up to deck level and the reinforced concrete deck system was built on them. This consists of transverse girders along the heads of the piles in each bent and longitudinal beams spanning from bent to bent carrying the floor beams and slab which was designed for a safe live load of 1,000 lbs. per square foot.

In order to protect the concrete against the action of frost and ice all surfaces between low water of spring tides and 18″ above high water of spring tides were sheathed with 4″ of creosoted plank.

The pier carries a two storey reinforced concrete shed 676 feet long by 200 feet wide and four railway tracks, one on each side of the shed and two down the centre inside the shed.

By the kind permission of R. H. Smith, A.M.E.I.C., resident engineer at Halifax for the Canadian Government Railways, the author was given an opportunity last month of examining the condition of the structure below deck level. In a few places only did there appear to be corrosion taking place in the reinforcing steel above high water and in these cases the reinforcing steel had been evidently misplaced during construction. This was particularly noticeable on the underside of the deck slab where the placing of reinforcing steel and holding it in correct position during the placing of the concrete is liable to be less carefully attended to than in the beams but where a good covering of concrete is just as necessary and should always be allowed for and insisted upon. An extra one inch of concrete on the underside of the deck not only gives additional protection to the steel but it adds to the stability of the structure by increasing its inertia which is an important point in these days of 40,000 and 50,000 ton vessels. In no place was any sign of corrosion discovered where the steel had been properly covered with 2″ of sound concrete. The greater part of the structure was five years old when the examination was made and the whole of pier had been completed four years.

The frost protection sheathing, where it had been undisturbed by vessels, was in good condition. In a few places this sheathing had been knocked off by vessels, and where this had occurred previous to last winter and had not been repaired the action of frost and ice on the concrete below high water could be seen. At one of the outer corners of the pier the lower part of one of the stiffening gusset walls had been attacked by frost until the concrete had been entirely removed from around the reinforcing rods. The concrete in this gusset wall had been poured in place at low water and as a contrast to its lack of durability when unprotected was the case of a pile which, having been broken while being placed, had been discarded and allowed to remain standing free and unprotected under the pier. This pile, made of 1:1 ½:3 concrete, had seasoned for nearly twelve months before being placed in the water and after five winters only a slight amount of abrasion had taken place between tide levels and this was little more than a rounding off of the corners. In no place was the steel exposed nor had any rust stains appeared, succeeding winters, however, will have a greater effect as part of the hard outer skin has now been removed.

Since the pier has been in use it has received several severe blows from vessels of all sizes, but in no case has there been any but local damage suffered by the structure. A few months ago a vessel with a displacement of over 40,000 tons collided with the pier while docking and although several of the side plates of the vessel were bent the concrete was damaged for a distance of not more than five feet in from the fender beam. The work was designed by Sir John Kennedy M.E.I.C., of Montreal, for whom the author acted as assistant and resident engineer. The contractors were the Nova Scotia Construction Company of Halifax and Sydney and the cost of the structure was about $1,000,000.00 exclusive of the interior fittings of the shed.

The Furness-Withy pier at Halifax, completed last year has a lenght of 590 feet and a width of 90 feet. It is supported on 76 reinforced concrete cylinders in 19 rows

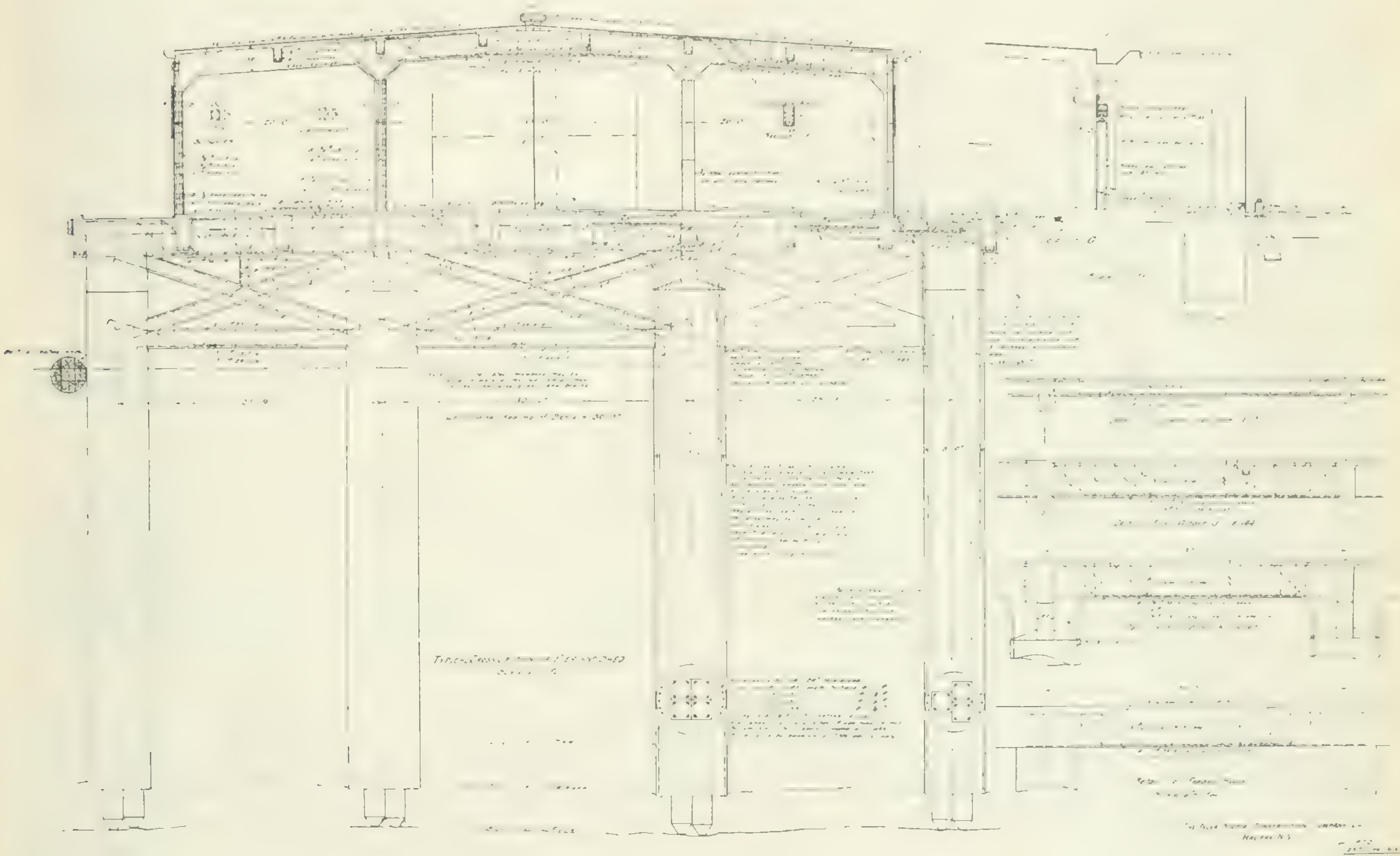
of four cylinders each, and a solid concrete retaining wall under the shore end. The depth of water alongside ranges from 13 feet to 46 feet below low water of spring tides. ¼" steel plate cylinders rivetted together were used as forms for the concrete supports and were left in place as a protection to the concrete.

The contract plans called for the driving of reinforced concrete piles within the steel cylinders except where the steel cylinders could be sunk to solid rock in which cases the piles were naturally to be omitted. The contractors decided that they would excavate to rock in every case and so eliminate the need of pile driving.

Probings to rock were taken at the location of each cylinder and the required length of cylinder sent to the bridge company who made up the cylinders and shipped them by rail to Halifax.

The foundations for a bent of cylinders having been excavated to rock, guiding timbers fastened to the pier falsework were set so as to hold the cylinders in correct position when being set. The cylinders, as required, were then tipped endwise into the water and raised into a vertical position by a floating derrick which set each in its location as marked by the timber frames.

A helmet diver was then sent down each cylinder



to thoroughly scrape and clean the foundation and also to close up any apertures which might exist around the bottom edge of the cylinder.

In shallow water a "Harris Excavator" operating an "orange peel" bucket was used for excavating the cylinder foundations. For about 200 feet out from the bulkhead this excavation had to be carried through old timber cribwork and a very tough boulder clay which it was found necessary to blast. Towards the outer end of the pier silt and stone filling only were found overlying the rock and these were easily removed by an ordinary "orange peel" bucket.

The two side cylinders in each bent are six feet in diameter and the two interior ones seven feet, and they are spaced 25' 9", 30' 0" and 25 '9" centre to centre.

Owing to the distance of 30' 3" between the bents of cylinders it was necessary to drive temporary wooden piles to support the formwork for the pier deck. Two rows of piles at ten feet centres were driven between each bent, capped with 10" x 10" timbers parallel to the bents and braced with diagonal bracing.

Before filling the steel cylinders a number of wooden piles were driven east of the newly set bent so that the empty cylinders might be held securely in a vertical and correct possition by bracing to these piles.

The concrete used for cylinder filling was mixed in the proportions of 1 part cement, 2½ parts sand and 5 parts broken gravel, and it was deposited under water by a bottom dumping bucket which held one batch of 20 cubic feet. 1¼″square twisted rods were set vertically inside the cylinders as the concrete came up. These rods were placed towards the north and south sides of the cylinders and their tops extended up into the superstructure of the pier in order to stiffen the work against lateral shocks. 1⅛″ square twisted rods were placed in a similar manner on the west and east sides of the two inside cylinders to give longitudinal stiffness. The number of reinforcing rods placed in each cylinder and their lengths varied with the length of the cylinder.

The concrete filling of the cylinders was brought up to two feet above the level of low water of spring tides in one operation. The laitance was then cleaned off and the necessary holes cut in the sides of the cylinders for the setting of the low water concrete braces.

These reinforced concrete braces consisted of two intersecting diagonal members 18″ x 18″ in section joined at their lower extremities by a horizontal member 18″ x 24″ and having a short vertical strut projecting upwards from the intersection of the diagonals. These members are heavily reinforced with 1″ and 1¼″ square twisted bars whose ends were bent and extended beyond the concrete to allow of their being thoroughly bonded into the cylinders and superstructure. Three braces were required in each bent, the centre one weighing about 14 tons and the two outer ones 12 tons each. In addition to bracing the pier they acted as trusses and stiffened the transverse girders of the deck. They were cast on shore and were well set and seasoned before being used.

The two centre cylinders of each bent were made of such lengths as to bring their tops to about the level of the underside of the braces and from that level to 7′ 6″ above low water they were continued in timber in two thicknesses, the inner 1″ being untreated spruce and the outer 2″ of creosoted hardpine. The outside cylinders were carried up to 7′ 6″ above low water in steel.

After the setting of the braces and the completion of the centre cylinders the concrete filling was brought up to the level of the underside of the deck girders.

All parts of the concrete braces below the level of 7′ 6″ above low water are sheathed with 3″ thickness of timber in two layers as described above.

The pier deck, of slab and beam construction, consists of a 6″ concrete slab carried by floor beams, londitudinal beams and transverse girders. The transverse girders, 20″ x 50″, extend from side to side of the pier across the tops of the cylinders and concrete braces. The longitudinal girders 18″ x 44″, run from bent to bent at ten feet centres, and the floor beams, 9″ x 18″, running parallel with the transverse girders, divide the deck into ten feet squares. The deck slab is reinforced in both directions with ⅜″ round rods at 6″ centres.

This arrangement of beams and girders lent itself well to the locating of the construction joints where these were least objectionable, which was midway between two bents. No longitudinal construction joints were allowed in the pouring of the pier deck, it being an unbroken rule that a complete strip 30′ 3″ wide extending from side to side of the pier had to be poured in one operation. Such a strip contained 140 cubic yards of concrete and was usually completed in less than nine hours.

The surface of the slab was graded, screeded and floated as the work proceeded, no top finish being put on afterwards. This insured a compact slab of at least the required thickness with no horizontal joints between concrete and finish. The centre 15 feet of the pier floor was laid level and grooved to furnish foothold for horses, the remainder of the floor is laid with a grade of 1 in 90 to each side.

The pier carries a reinforced concrete shed 514 feet long by 70 feet wide. The walls of the shed are of 6″ concrete stiffened with pilasters. There are two interior columns, 14″ in diameter, in each bent dividing the shed into 20′, 30′ and 20′ bays. The height of the shed at the eaves is 16 feet rising to 18 feet along the centre line. The transverse girders are 12″ x 30″, the longitudinal beams 10″ x 21″ and the roof slab is 3½″ thick reinforced with wire mesh, and waterproofed with tarred felt, pitch and gravel roofing.

The doorways through the end walls are 18′ wide by 14′ high and are provided with steel frame and plate sliding doors. The side doors are 12 feet wide by 14 feet high at 30′ 3″ centres provided with metal covered wooden doors. All doors are carried on R–W overhead door hangers and tracks.

Offices for customs and shipping clerks are provided at the shore end of the shed, also a heated storeroom for perishable goods. The shed is lit inside and out with electric lights.

The main concreting plant used for the work was a one yard Ransome concrete mixer mounted on a travelling tower. The tower travelled on tracks laid on the pier deck and was equipped with separate hoppers for stone and sand. It also carried a loading derrick fitted with a ½ yard clam shell bucket for handling the stone and sand which were brought alongside the work on scows. The concrete was elevated to the top of the tower and from there distributed by chutes.

The pier deck was desiged for a live load of 600 lbs. per square foot, the beams and girders being figured as T beams with a maximum compressive stress in the concrete of 650 lbs. per sq. inch and a tensile stress of 16,000 lbs. per square inch in the steel. The roof of the shed was designed for a live load of 30 lbs. per square foot. The concrete of the pier deck and shed was proportioned 1:2:4.

The work was carried out by the Nova Scotia Construction Company under the superintendence of Hamilton Lindsay, A.M.E.I.C., to whom the sugestion of the type of construction used is due. The details of the design were worked out by the author who acted as engineer in charge for the Furness–Withy Company.

The effects of the great explosion of last December were heavily felt at both pier No. 2 and the Furness-Withy Pier. Steel and wooden doors were bent and twisted, windows were blown in and interior partitions shattered but the concrete structures themselves came through undamaged, even the light roof slab showed no signs of failure.

Explosion damage.—An examination of the piles in pier No. 2 below water level made by divers shortly after the explosion failed to disclose any damage either from the explosion or from the sea water.

In conclusion, it is well to impress the following points which require particular attention in the successful use of reinforced concrete in marine structures:—

1. Only rich, dense concrete of first class quality in every respect of materials and workmanship should be used. Fresh water only should be used and excess of water in mixing should be particularly guarded against as also too dry a mixture.

2. The building of the forms should be carefully inspected and watertightness, as far as possible, sought after, so that stoney streaks from which the liquid cement has leaked may be eliminated. A smooth face is very desirable.

3. All reinforcing steel, whether in piles, slabs, beams or walls should have at least 2″ of sound concrete convering and more wherever practicable.

4. In climates where ice occurs during the winter all concrete surfaces between low water of spring tides and some distance above high water should be protected by timber or other sheathing. In warmer climates a similar protection would probably be found beneficial as a protection against the continual drying and wetting of the concrete which action appears to have a tendency to increase its porosity. The sheathing would also protect the concrete against abrasion by floating debris and the chemical action of the seawater.

5. Precast members are better than concrete cast in place, especially below high water level. Concrete piles should always be long enough to reach above high water after being driven.

6. The painting of all concrete surfaces above high water and below deck level with a waterproof paint in order to exclude the salt moisture laiden air should be considered expecially in warm climates In place of paint a more permanent waterproof protection might be obtained by applying a good coat of cement "gunite." This is a question which has yet to be settled, and it is a very important one to the life of reinforced concrete in sea water.

7. And lastly that careful periodical examinations, at least twice a year, should be made of every reinforced concrete marine structure so that deterioration of the concrete, corrosion of the steel or displacement of the protection sheathing may be discovered as soon as possible and the necessary repairs be made at once before serious trouble sets in. The idea, that a reinforced concrete structure is one which can be left to look after itself and which will require no maintenance, is not only a mistaken one but a very dangerous one.

President Vaughan opened the discussion by recalling a paper read before the Franklin Institute some years ago explaining that the cause of the deterioration of reinforced concrete when exposed to sea water was due to the fact that a continual increase in volume takes place in the reinforcement on account of the chemical action to which it is subject. The paper just read was of considerable value and apparently placed the use of reinforced concrete on a pretty permanent basis. Continuing, he thought there should be a very complete discussion on this important subject.

Roderick McColl, M.E.I.C., asked if there was any special difference between the action experienced when metal was used for reinforcing and when it was not, and if the use of creosoted wood was economical? Replying, the author stated the trouble was experienced wholly between tide levels and was due for the most part to the action of frost and ice. In salt water the greatest danger to reinforced concrete structures is the action which takes place above high water level. The action below high water can be taken care of in the same way as the action on plain concrete. Corrosion above high water is apparently due to the salt-laden air getting into the concrete and ultimately working its way to the steel, causing corrosion of the metal and deterioration of the concrete by which cracks were formed allowing the moisture to get in and ultimately causing disintegration. In connection with creosoted timber, that point was raised in a discussion two or three years ago in the Institute of Civil Engineers and it was pointed out then that if plain untreated timber had been used it would have frozen but that creosoted timber throws off the water and does not freeze. In these waters, the creosoted timber will last longer, not being subject to the attacks of the teredo and the limnoria. The extra cost of creosoting was he thought, worth while.

Dr. Martin Murphy, M.E.I.C., on being asked to add a discussion, stated that similar piles of cylinder-concrete construction were used in several parts of the province and they work remarkably well. In connection with concrete piles, he thought they required most careful consideration and should be made as strong as possible. He did not know if the wharves now being built were after all stronger and better than those built years ago.

In response to a question from A. J. Barnes, as to what care was being taken to look after the steel columns where they were showing signs of depreciation between high and low water, the author stated that the steel cylinders were painted before being put down and that a few months ago an oil tanker had emptied her cargo into the harbour resulting in the oil cylinders being coated with an inch of so of heavy black oil which was acting as an excellent preservative against corrosion. He believed something should be done to keep them from corroding. Below salt water they would wear away very slowly taking probably from twenty to twenty five years to disappear, after which there was still the solid concrete inside.

Trip on the Harbour

Following the conclusion of the discussion on this paper, the members boarded the Government steamer, *Bayfield* as guests of the Board of Trade and were taken from the harbour around Bedford Basin, and returning, disembarked at the Waegwoltic Club on the beautiful North West Arm, the visitors being guests of the local members. This trip was greatly enjoyed by every one as it gave those from outside an excellent opportunity of appreciating the splendid harbour at Halifax and of viewing the far famed beauties of the North West Arm.

Third Session

8 p.m., Wednesday, September 11, 1918.

At the evening meeting, which was opened on the return of the members from the Waegwoltic Club, J. J. MacDonald, A.M.E.I.C., assistant engineer, Halifax Ocean Terminals, read his paper, which was fully illustrated by lantern slides, on

Diving Bell in use at Halifax Ocean Terminals.

Introduction.

The construction of the *New Ocean Terminals* at Halifax has attracted considerable attention, not only on account of the bold magnitude of the project but also because of the interesting features of design and methods of construction.

Among these features and methods perhaps none impressed the minds of observers, both lay and professional, as more novel than the so called *Diving Bell*, which was in operation on this work during 1915 and 1916.

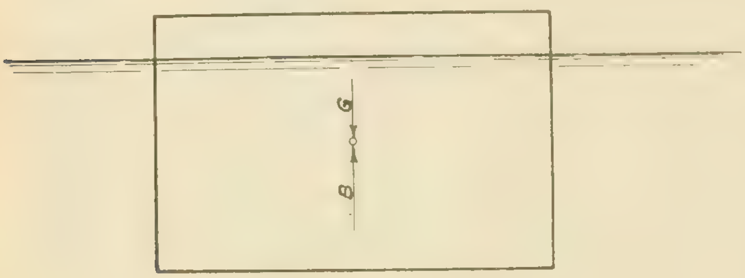


FIG I.

In this paper it is proposed (a) to outline the *function design, construction* and *operation* of this Diving Bell; (b) to formulate the principles of design developed which are applicable to future work of this type; and, (c) to point out, in a general way, the fields of work for which plant of this type promises applicability.

Function of the Diving Bell

In the layout and construction of the landing quay and piers of the Halifax Ocean Terminals the quay walls are the most important element. The harbour bottom at the site is rock of a shale formation which has been subjected to much irregular movement and distortion. Its depth varied from 20′ to 50′ below the datum (L. W.L. O. S. T.), except for two sections aggregating about 1,400′ in length, measured along the quay walls, where the depth is from 55′ to 70′ below datum. This rock was overlaid by a layer of black mud, etc., ranging in thickness from 2 to 10′, except at the section where rock is from 60 to 70′ below datum, where it was overlaid by 15 to 30′ of glacial deposits of red and blue clay interstratified with sand.

The natural conditions of the site and the imposed requirements of permanent work of an attractive appearance and, necessarily, massive character, led to the adoption of the solid type of quay wall. The problem of building this wall, (of which there are about 6,530 lineal feet in the first unit of construction) at maximum speed and at a cost comparable with that of any alternative method, was solved by the development of the "cellular reinforced concrete block" method of construction.

The concrete quay wall, to be thus constructed, varies in depth from 30 to 45′ below datum, and is founded upon the rock bottom dredged to required level, except in the deeper sections aforementioned, where a spread rubble base up to 45′, (below datum) level is provided. The construction of the wall of cellular blocks placed in stacks demanded in general a means of cleaning and inspecting the bottom before the blocks were placed, and, in particular, a means of placing supports or pedestals at accurate elevation to receive the base block and support the whole stack and erection plant, until the concrete filling was deposited.

It is well known that the pneumatic caisson furnishes the most reliable method of sub-aqueous foundation work. It was decided to apply the pneumatic caisson process on this work to an area about 36′ wide by 6,530′

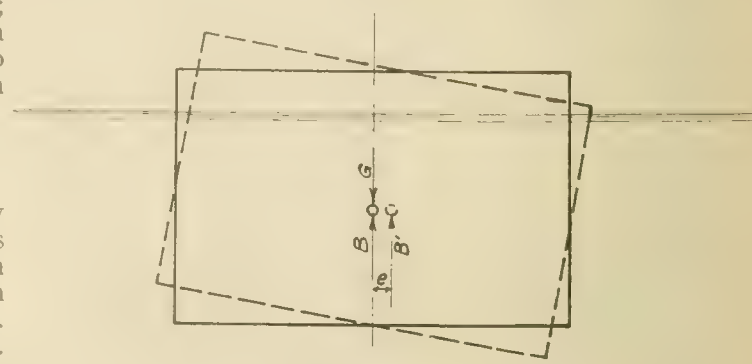


FIG 2

long, at depths of water varying from 30′ to about 55′, (allowing for rise of tide). Moreover, the comparatively small amount of work required per unit of area, neces-

sitated rapid and economical movement of plant. The *Diving Bell*, used at the Halifax Ocean Terminals, was designed to meet these conditions, so unusual in the application of the ordinary pneumatic methods of foundation work.

Design of the Diving Bell

For reasons of economy and adaptability to the conditions, it was decided to adopt a self-floating, submerging and raising type of mobile pneumatic caisson or bell.

The size of the bell in plan was determined so that the foundation site for one wall unit, i.e., 22′ x 34′, the area of one base block, could be covered, with a small margin to take care of inaccuracy in setting. This gave 26′ x 38′ as the horizontal dimensions at the cutting edges.

It was considered that the required foundation work could be done in a unit of this size at a speed which would keep ahead of the actual wall construction as determined by the period of time provided for in the contract; that a higher speed would not be desirable because the foundations prepared would become fouled with mud, etc., thus requiring a second cleaning, before the placing of the wall blocks.

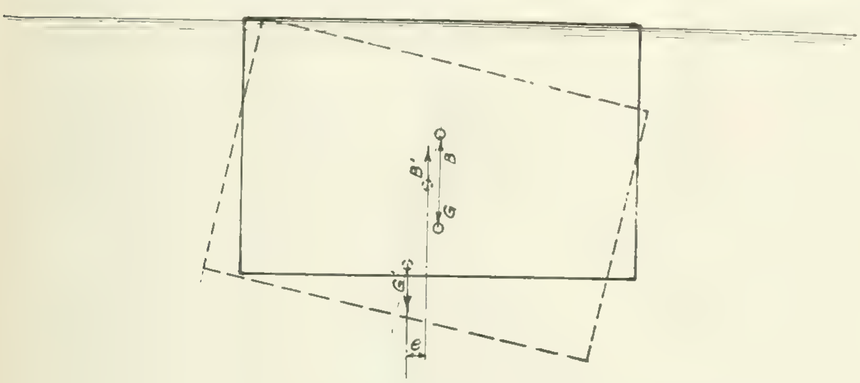


FIG. 3

Moreover, it was expected that the slope of the rock bottom along several lengths of the wall would admit of a stepping down of the foundations of consecutive stacks. This size of bell would allow of full utilization of such an arrangement.

Having decided upon the dimensions at the cutting edges, the fundamental conditions for this special type of caisson or bell were investigated and adduced as follows:

Fundamental Conditions

I. *Working Weight.*— Bell as submerged under working conditions must have a weight when reduced by buoyance sufficient to withstand the uplift of the air-pressure in the working chamber, with a margin to take care of conditions which require foundation work to be carried somewhat below the level of the cutting edges. This excess of weight must also provide safety and steadiness against ground swell of the sea, etc.

II. *Flotation.* — Bell must float, when required, with a draft, in general, as shallow as practicable for ease in handling and launching, and in particular, sufficiently shallow to pass over the highest portions of the foundation site.

III. *Stability.* — Bell must be stable, (a) in flotation to withstand wind and rolling of the sea, while at anchor or under tow; (b) while submerging or sinking, so that it can be landed with ease and accuracy; (c) while rising.

Application of Conditions

Condition 1.— The dimensions of the working chamber were first determined. It was made 7′ high. From considerations of strength and rigidity the cutting

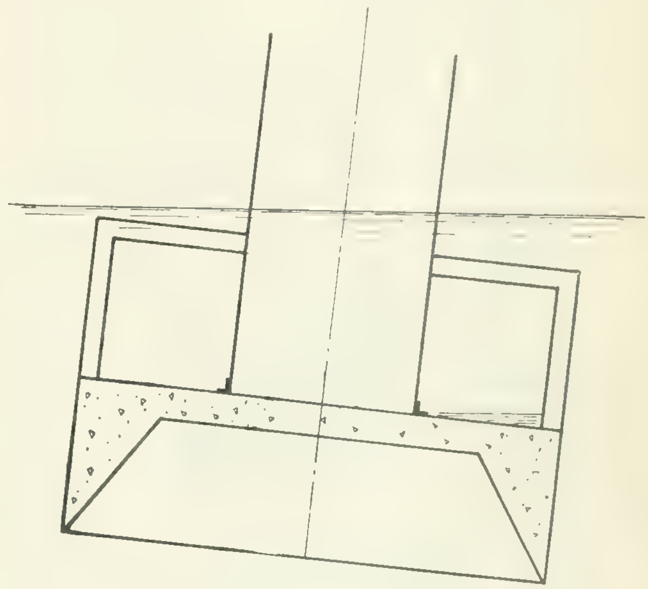


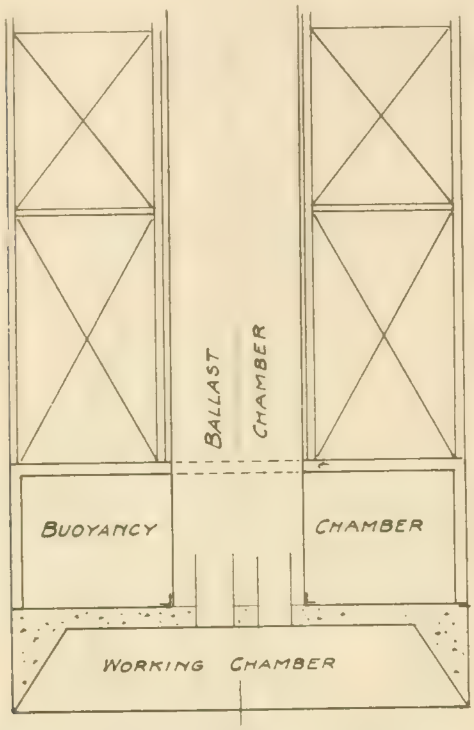
FIG. 4

edges were made 4′ 3″ thick at the roof level. Then the volumes of the working chamber and the cutting edges were calculated. For a caisson of this type for use upon a variety of rough rock settings, subjected to frequent moving and under which some blasting would be required, it was decided to use concrete stiffened and armored with steel for the cutting edges, and concrete covered with an air tight skin plate for the roof of the working chamber.

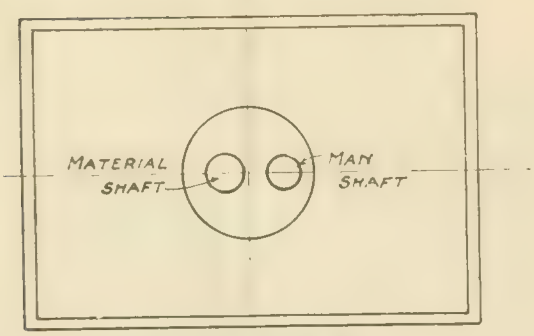
According to condition 1, the weight reduced by buoyancy of the whole structure = V.W., where V — volume (in cu. ft.) of working chamber, (including shafts to level of water surface) + Area of working chamber at cutting edges x depth assumed to give excess weight, and W = weight per unit, volume, (cu. ft.), of the water.

In this case a depth of 2.8′ was taken to give excess weight and actual tests of the water of Halifax Harbour at the Terminals site, gave W = 63.74 lbs. per cu. ft.

At this point it was necessary to determine the layout of shafts, locks, etc. It was decided to use a 30″ manshaft and 36″ material shaft. The weights of the shafts were computed and a weight estimated for the locks. Then the working weight of the bell was calculated as follows:



LONGITUDINAL SECTION



PLAN AT TOP OF BUOYANCY CHAMBER

FIG 5

Vol. working chamber...... = 5,120 cu. ft.
" Shafts, (for 50′ depth)... 510 "
Excess weight = 988 x 2.8....2,770 "

= 8,400 "
x 63.74 = 535,000 lbs. (approx.) = 268 tons.

Condition 2.— To take care of this condition, a buoyance chamber was placed on top of the concrete roof of the working chamber, and it was made of the same horizontal dimensions as the cutting edges. The imposed condition for the buoyance chamber was, that the volume of the water which could be displaced from it should equal the volume of working chamber and shafts + volume of working weight + displacement of free-board and top-frame work. It remained to determine its required height.

First the question of free-board and the disposition of the material of the bell had to be settled. Before this could be done the method of operating the bell had to be studied in detail and decided upon and the consequent type of construction determined. This led into condition 3.

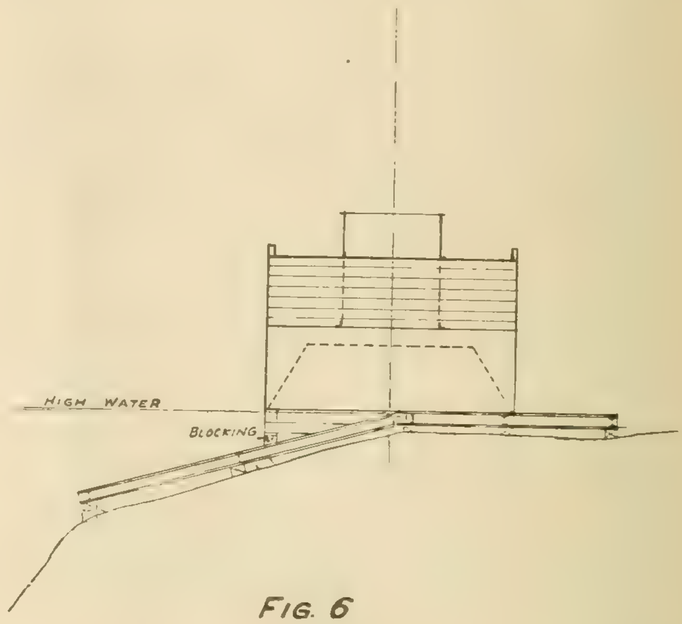


FIG. 6

Condition 3.— In connection with free-board and requirements for sinking and raising, the general problem of flotation had to be look into.

Stability in Flotation

For the sake of clearness in this discussion, the following resumé of hydrostatic principles is given:—

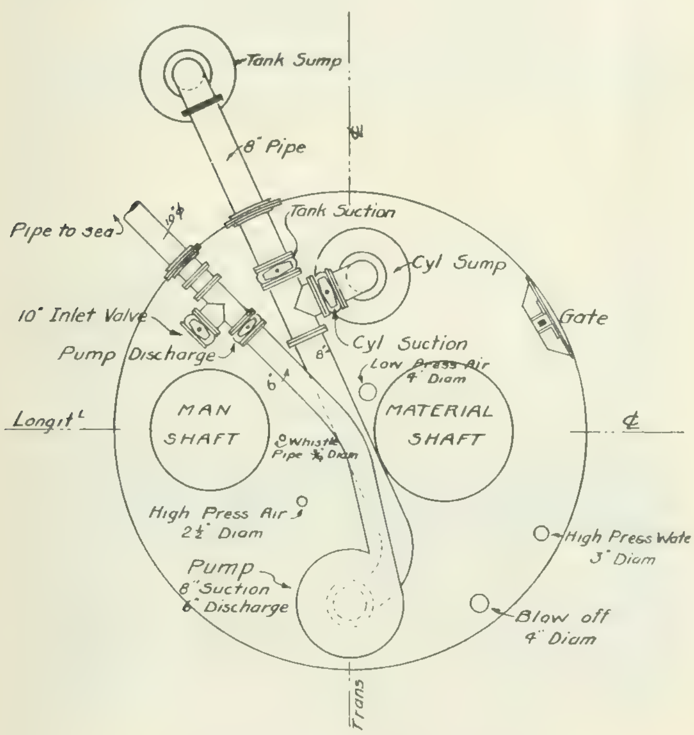
Consider a floating body as in Fig. 1. The body sinks until the weight of the displaced fluid equals the weight of the body. Call the centre of gravity of the body G., and the centroid of the volume of displaced fluid (i.e. the centre of buoyancy) B. Then, for equilibrium in free flotation, the forces G. and B. are equal in magnitude, and act in the same vertical line; but, if the body is acted upon by horizontal or eccentric vertical forces, the tendency will be to rotate or careen it and, for flotational stability, the condition is that the body shall offer sufficient resistance to careening forces and shall return quickly to the original position when these forces are removed. It depends upon two factors, viz.:— free-board and the relative positions of the centres of gravity and buoyancy.

Assume G. and B., at the same point as in Fig. 2, body floating with free-board. If the body is rotated into position shown by dotted lines, G. will remain at same point, but B. will move to the right from the geometry of the fig. Consequently, the body will be subjected to a righting moment = Ge. tending to restore the body to its original position.

Assume body floating with practically no free-board as in Fig. 3. If body is rotated as indicated by dotted lines, the forces G. and B. are separated laterally as shown and the body is subjected to a righting moment = Ge. It is manifest that if G. and B. be only a small distance apart vertically, a large angle of careen is necessary to induce any considerable righting moment and that the body will be relatively unstable in flotation and easily subjected to oscillation.

In general, floating bodies depend upon both of these factors for stability.

The *Diving Bell*, when floating, has to carry a framework with top platforms and heavy locks and gear about 35′ above water level. It was judged that a free-board of 8″ would provide sufficient flotational stability for the *Bell*.



SECTION OF BALLAST TANK SHOWING ARRANGEMENT OF PUMP AND PIPING FIG. 7

Sinking and Raising Bell

The obvious means of sinking the *Bell* was water-ballast admitted into the buoyancy chamber through sea valves. Were a volume of ballast equal to or slightly greater than the free-board displacement admitted, the bell would sink to the bottom with an accelerated velocity. Moreover, while sinking, the stabilizing effect of free-board would not be available; hence, it was necessary to provide a means of controlling the sinking of the bell and ensuring sufficient stability while submerged.

Again, the volume of water ballast required to sink the bell would fill only a small proportion of the buoyance chamber, say not over one foot of depth in the tank. The surge effect of this water ballast when the bell rolled would be to move the centre of gravity as shown in fig. 4, and render the bell unstable; hence, means had to be provided to prevent this surge of ballast — It was decided

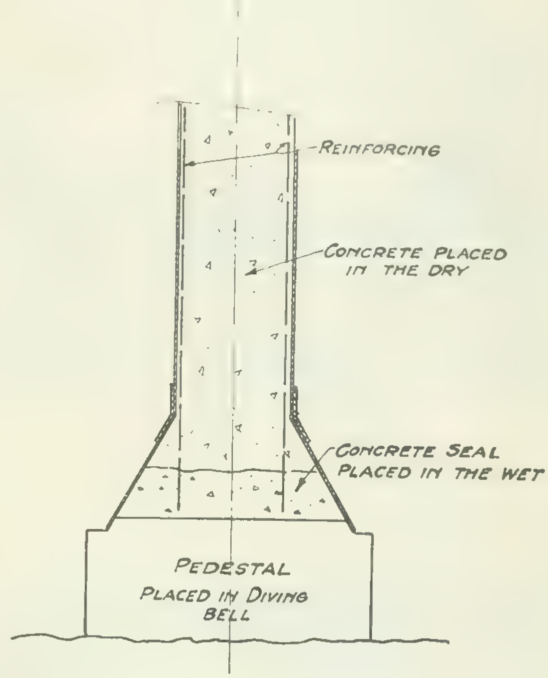


FIG. 8

to place a central compartment in the buoyancy chamber, extending from the floor to the roof, of volume sufficient to submerge the bell. To give a control while submerged so that the sinking could be stopped and the bell held at any level in the water this compartment or chamber was extended up above water level. It was made sufficiently large so that when the roof of bell was submerged the level of ballast in the compartment was considerably below the outside water level. In this way the centre of gravity was lowered relatively to its centre of buoyancy and when bell careened a free-board effect was imparted by this chamber. In addition it provided a suitable means of supporting and protecting the shafts, airlines, etc., leading to the working chamber.

For reasons of structural economy, this compartment was made cylindrical in form. It is hereinafter called the ballast chamber.

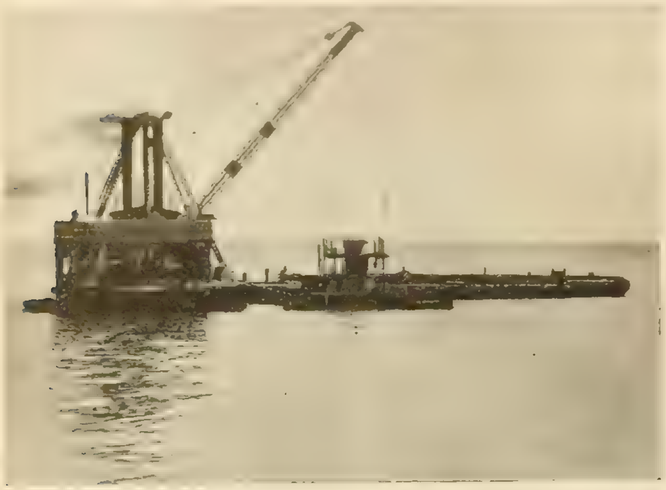
See fig. 5 for diagram of bell.

A complete cycle of sinking and raising the bell was now outlined as follows:

I. Bell floating, no air in working chamber or shafts, buoyancy and ballast chambers empty.

II. Sea-valve opened, water admitted to ballast chamber. As it fills, deck of bell submerges, and bell sinks slowly until cutting edges rest upon the bottom.

III. Water admitted to buoyancy chamber until it is full, the working weight thus provided.



Bell Working at 55′ Depth

IV. Compressed air admitted to shafts and working chamber, expelling the water. Bell now in working condition.

V. Air in working chamber and shafts released — bell returns to phase III.

VI. Water expelled from buoyance chamber — bell returns to phase II.

VII. Water expelled from ballast chamber — bell returns to phase I — or floating condition.

It was necessary to provide means of carrying out all the phases of this cycle and to build a bell structure to withstand the resultant loads which each phase might impose.

Method of Handling Water Ballast

It was first contemplated to use air from the compressors to force the water from ballast chamber and buoyancy chamber in raising the bell. This method required practically air-tight buoyancy and ballast chambers.

Consider bell in phase II. The walls and deck of the buoyance chamber, assuming it open to atmosphere on the inside, are subjected to heavy external pressure (63.74 x 43 = 2,700 lbs. per sq. ft. on walls for bell at full depth). The same conditions would obtain in phase VI, if buoyancy chamber were open to atmosphere. This external pressure could be counteracted by admitting compressed air into the buoyancy chamber as the bell sinks and increasing the pressure in proportion to the depth. Then to fill the buoyancy chamber with water, this air would have to be blown off gradually while maintained at its gauge pressure, until the chamber is completely flooded.

One disadvantage of this condition would be the increased time required to fill the chamber as the inflow would depend upon the difference between the head and the internal pressure.

Again, in phase VII. If the air pressure used to expel the water as in phase II, were not released and the sea valve connection of the buoyancy chamber were closed, the walls and deck of this chamber would be subjected to a high internal pressure, as the bell came to the surface. It is evident from these considerations, that accidents, such as the breaking of an air line, or the carelessness or mistake of a workman might destroy this balance of pressure. Something might be done to relieve the excessive air-pressure by the use of safety-valves, etc., but such an arrangement could not be depended upon to take care of the external water-pressure.

Design of Structure

From the foregoing considerations, the buoyancy chamber was designed to withstand full external pressure. The use of steel plates made an expensive layout; so, it was decided to use timber for the walls and roof of this chamber. This could be readily built and caulked to withstand water pressure from the out side, but did not lend itself to the holding of air and withstanding internal

Diving Bell Working at 35′ Level

pressure; hence, it was determined to remove the water-ballast simply by the use of a pump. This scheme was the more readily adopted because it was considered that the bell could be moved to an adjacent setting with the air in the working chamber by removing the load on the cutting edges, and raising the bell slightly; which could be done by pumping out the water in the ballast chamber (with a small quantity from the buoyancy chamber if required.)

It was proposed to steady the bell in this operation by lines to its attendant scow if necessary. In this way, the volume of air wasted and the pumping required would be minimized.

With these general conditions fixed, a tentative layout was made for the construction of the buoyancy chamber and a preliminary estimate taken out for the quantities of timber and steel required. The working weights having been pre-determined and the weight of the cutting edges, with a provisional weight and volume

Diving Bell Working at 37′ Level

of the material in the buoyancy chamber, ballast chamber, etc., above the concrete roof, the height required for the buoyancy tank, to give the pre-determined free-board, was calculated and a tentative figure made for the thickness of concrete roof required to give the necessary weight. With the general dimensions thus determined, the stresses and sections for the structure were taken out.

A steel frame-work was laid out consisting of two longitudinal trusses and two transverse trusses. These were framed into diaphragms at the ends which extended down to the cutting edges. Between these, additional diaphragms and frame-work to support the 12″ x 12″ long leaf pine timber of the sides and decking of chamber were placed.

Riveted to these diaphragms, on the outside were heavy plate girders, made up of 114″ x ½″ plates with 6″ x 6″ x ⅝″ flange L's. These plate girders formed the outside of the cutting edges. Inside the working chamber the skin plates were riveted to the diaphragms and the bottoms of the trusses and frame-work. See sheet "structural details."

Stresses

The stresses in the frame-work, were analyzed for the following conditions : (a) launching stresses, (b) stresses due to water-pressure while sinking or rising (c) stresses due to weight of structure in the water, supported in critical positions. Members were designed to resist any of these stresses acting separately, or any possible combination of them. For the stresses due to these conditions, in which the maximum possible load could be estimated, and there was no liability to shock from sudden application, allowable stresses were taken at 22,500 lbs. per sq. in. in tension and $(22{,}500 - 70\,{}^{l}/_{r})$ in compression.

The reinforced concrete roof of the working chamber was designed to withstand full upward water pressure with bell in phase II or VI.

Checking Flotation Condition

When the detail drawings were made, the weights were carefully recomputed and the position of the centre of gravity of the bell as a unit was calculated; the stability in flotation was then checked up by plotting the meta-centre for different positions of the bell. It was found, as was to be expected, that the critical condition, re stability, would occur when the deck of the bell had sunk a short distance below the water. In this position, the centres of buoyancy and gravity were practically co-incident and consequently there would be no righting moment to prevent careening.

To remedy this condition, old rails to the extent of about 25 tons were packed around the cutting edges; thereby the centre of gravity was lowered.

To provide the additional buoyancy required to float this weight, the buoyancy chamber was made 1′ higher; thereby the centre of buoyancy was raised. The necessary revisions were made for the details of frame-work, etc.

Data re Weights, Etc.

In computing the dimensions of the buoyancy chamber, the weights of timber and concrete to be used,

Placing Pedestal in Working Chamber

could not be pre-determined exactly. The weights when water soaked were the governing ones. Hence, it was specified that before the rails were placed in the cutting edges water soaked samples of the timber and concrete to be used should be weighed and with the data thus obtained the quantity of rails required should be recalculated.

It was found that the timber, long leaf yellow pine, weighed 56 lbs. per cubic foot, and the concrete, (not including re-inforcement) weighed 150 lbs. per cubic foot These figures agreed with those assumed in the design. When the bell was finally launched, the free-board was practically the same as had been pre-calculated.

Construction and Launching

The steel work for the bell was erected on launching ways, composed of I beams, tied together with cross I's and diagonal bracing made of turn buckle rods. On

Bell Ready for Launching

top of the ways, channel shoes were placed and on these, the bell was supported by placing oak timbers under the angles of the cutting edges. The bell was placed so that it cantilevered about one-half over the pivot points of the ways — the projecting end being blocked up on 12″ x 12″ timbers.

The arrangement of the ways is indicated by Fig. 6.

The steel work of the bell was fairly complicated, owing to the bevelled connections and bent plate work required at the corners and the flanging of plates in the working chamber. The outside girders were set in place, the trusses erected and connected to the diaphragms and the skin-plate of the working chamber riveted up. Then the old rails were grouted into the cutting edges, the roof reinforcement set and the concrete of the cutting edges and roof was poured. Then the timber work was placed and caulked and two sections of the ballast chamber and shafts set up. In this condition the bell weighed about 420 tons. The launching proved a slow and laborious undertaking. Firstly, it was found difficult to remove the timbers from under front end of bell. When the bell finally swayed over and started down the ways, it moved only a foot or two when the longitudinal I's tore away from their cross frames and crumpled over on their sides, and the mass of the bell imbedded itself into the shore gravel.

From this position it was slowly jacked out until it floated clear. Before launching, temporary heads were placed on the shafts and through these compressed air was admitted to the working chamber during the launching but owing to the sloping position of the bell, it had practically no buoyant effect.

The failure of the launching ways was due to uneven settlement and inadequate connections at the cross-frames. The method of pivoting adopted was not suitable for the handling of so heavy a structure.

The top frame work, shafts, locks and all other fittings were placed while bell was afloat.

Operation

A centrifugal pump on a vertical shaft directly connected to a motor placed at the top was installed to handle the water ballast. The pump itself was placed on the bottom of the ballast chamber. A small sump was placed in the bottom of this chamber and in the bottom of the buoyancy chamber, to either of which the pump suction could be connected. The pump discharged directley through a pipe to the sea-valve.

It was proposed to fill the buoyancy chamber from the ballast chamber by opening a gate-valve in the separating wall. The arrangement of piping, etc. is shown in Fig. VII.

An inherent defect in the unwatering system became manifest the first time the bell was submerged. It happened that the cutting edge landed with one side on a high point of rock — so that the bell was thrown over at an angle of 10° to the vertical. Although the buoyancy chamber was not flooded, some water leaked into it before it was attempted to raise the bell. When the ballast chamber was unwatered, the bell rose some distance from the bottom; but the water in the buoyancy chamber prevented complete flotation and it proved impossible to remove this water with the pump, because it surged from side to side with the slight roll of the sea, so that the bell reeled like a drunken man and the water could not be collected by the sump.

As this condition was liable to occur at intervals in the work, a remedy had to be devised. The writer suggested the installation of a cylinder pump upon the deck of the bell, to be connected to a suction pipe at each corner of the buoyancy chamber; each pipe to be fitted with a valve with stem extending to the upper platform. The contractors, however, lined the inside of the buoyancy chamber with rubberoid, covered with sheathing, and made

connections to admit air into the chamber from the compressors and fitted a blow-off pipe with valve at each corner. By this method the water was forced out of the corners, but the chamber soon became very leaky, on account of blowing out the caulking.

In the construction of the bell a sump should have been placed at each corner of the buoyancy tank and connected by a branch pipe, with valve, to the pump suction.

In actual operation the bell was moved to an adjacent setting as follows: The buoyancy tank was unwatered; then a volume was pumped out of the ballast chamber sufficient to raise the cutting edges clear of the pedestals. The bell was then warped to the next site. On account of the conditions outlined above, it became necessary to maintain air pressure in the buoyancy chamber to counteract the leakage.

Line and levels were transferred to the working chamber at each setting as follows:

Points were located on the upper deck of bell from transit on shore. The distances from these points to fixed reference points at the corners of deck were measured and the angle inclination of bell, (from plumb), observed. Then by calculation, line and position were set out in working chamber by measurements from fixed reference points at the corners of chamber. The levels were given on the top of lock and transferred directly through the man shaft by a steel tape to a bolt driven in the rock in working chamber which served as a B.M. for the setting.

Auxiliary Plant

In the operation of the bell, plant used was as follows:

1 Tender scow, steel frame, 100′ x 32′ x 4′ 8″
2 Steel water tanks
1 20 ton derrick
2 No. 13 "Ames" locomotive type boilers
1 "Beatty" 3 drum hoist without boiler
1 "Mead Morrison" derrick swinging engine
1 No. 7 "Vim" engine
1 10″ x 10″ x 12″ Rand straight line air compressor
1 36″ x 8′ Rand air receiver
1 12″ x 16″ x 12″ Rand compressor
1 42″ x 10′ Rand air receiver
1 Blake Knowles 10″ x 6″ x 12″ duplex pump
1 "Bowden" boiler feed pump
1 25 H.P. adjustable speed motor set
1 Morris submerged centrifugal pump
1 Man lock with 2 air lock doors
1 Air lock for material shift.

The air was supplied to the working chamber from the low pressure reservoir on the scow, and a high pressure line was installed in the bell for use in drilling, etc.

The working chamber and shafts were lighted by electricity supplied by the motor on the scow.

The working chamber was equipped with a 4″ blow pipe, a ¾″ whistle pipe and a 3″ wash-pipe. These with the high and low pressure air-pipes, extended from the roof of the working chamber, through the ballast chamber to the top platform.

In carrying out the work at Halifax all the rock foundations were prepared with the diving bell, but on the rubble mound foundations it was not used. On this portion of the work bag work was placed continuously along the lines of the toe and heel of the quay wall by helmet divers. The bag work was checked to correct elevation by hanging screeds suspended from a framework above water level.

Costs of Plant and Operation

The first cost of the diving bell was about.... $17,000.00
Contract was let in spring of 1914.

Tender Scow with equipment — cost about... $24,000.00

In the operation of the diving bell the costs were approximately as follows:

Labor, 3 shifts of full crews, per 24 hrs....... $131.00
Supplies — oil, etc., per 24 hrs................ $10.00
Coal, per 24 hrs., 8 tons.

To these figures must be added the cost of daily tug service, which in this case was computed at per 24 hrs.................................... $30.00

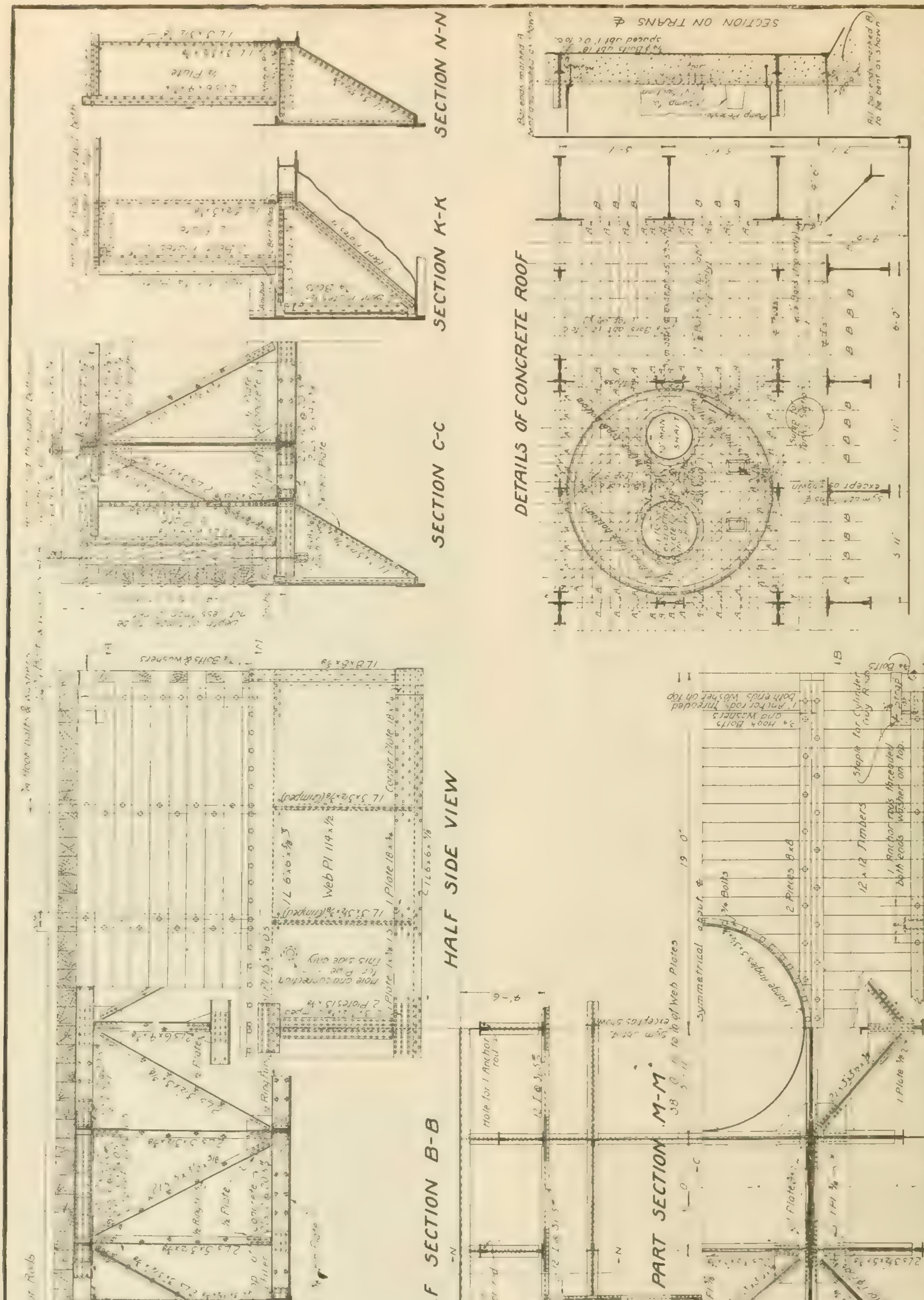
The speed of the work varied considerably according to the condition of the bottom. During the latter period of this work 5 sets per week were generally made — and the best record was 6 sets per week. The foundations were prepared and the pedestals placed for one wall unit, 34 ft. x 22 ft. in area, at each setting.

General Principles of Design

For the design of plant of this type, we may summarize as follows:

Data required.— Range of depths at which *bell* is to be used; Area required to be covered at one setting. With respect to the area, it will generally be fixed as a minimum only by the character of the work. The question of covering a greater area will depend upon operation economy. It may be stated as a general principle, that a bell covering a large area will be more economical in operating costs, as the work of edge levelling will be reduced and the cost ratio of lock tenders and other plant assistants cut down. However, the size will be limited by the consideration of moving materials to and from the material shaft. For a very large bell it would pay to install two or more material shafts with locks.

Procedure.— Fix area at cutting edges and depth of working chamber; compute sections and weight of cutting edges. Decide the size of shafts and locks to be used and estimate their weights. Then determine the working weight equals volume of working chamber and shafts x unit weight of water + excess weight. Selecting the plan area of the buoyancy chamber, (in general same outside dimensions as cutting edges) calculate the depth required for the chamber to float the bell; add to this the depth for free-board. Decide on the scheme of operation, i.e., whether ballast is to be handled by pumps or compressed air; determine also the method of controlling the sinking and raising of bell, i.e., the size and weight of the ballast chamber to be used.



STRUCTURAL DETAILS OF DIVING BELL
HALIFAX OCEAN TERMINALS

With the method of operation fixed, and the character of the structure and the materials selected, make an estimate of weight for the frame-work, sides and roof of the buoyancy chamber. Deduct the summation of these weights from the working weight, the remainder must be supplied by the material, (say concrete) in the roof of the working chamber; hence, determine its thickness.

All main dimensions are now fixed tentatively. Lay out the framing system, compute stresses and select sections; check up the stresses in the concrete roof and calculate the reinforcement required.

At this point check up the weights approximately; If O.K. detail

When detail drawings are complete, take out a final check on the weights and depth of flotation; also check up the stability by finding the centre of gravity and the centre of buoyancy for critical conditions.

General Application for Plant of this Type

It may be stated at once that the floating caisson of diving bell can be used only for work on or near the surface of bottom, whether that surface be the natural one or one left by dredging or filling.

For work such as the majority of bridge piers, which are carried down to a bearing stratum through a considerable depth of overlying material, the diving bell would not be suitable, except in cases where the soft material over the site could be removed, (with an orange-peel at clam shell bucket say); the bell could then be sunk and the excavation carried down for some distance through stiff material and the rock levelled and cleaned preparatory to setting the pier crib.

The proper field is the preparation or finishing and inspection of sub-aqueous foundation work covering a large area on rock, gravel or other bearing material.

In recent years the open type of reinforced concrete pier construction has been developed in America. It may be divided into two general classes, (a) for bottoms of penetrable material the pier deck is carried by piling (either reinforced concrete or timber); (b) for bottoms of rock or gravel, concrete cylinders are used to support the deck. It is for the cylinder construction that the diving bell promises to be especially useful.

In work of this kind, the base-area of the cylinder is determined by the allowable unit foundation pressure. The safety of the whole construction is dependent upon the conditions at the base of the column or cylinder. With ordinary methods of construction, it is difficult to insure evenness of bearing and soundness of material at this vital section; particularly in the case of a rough rocky bottom.

As generally employed, this cylinder is carried up from the foundation with a uniform section. This results in low stresses and waste of material, except at the base.

By using a *diving bell*, a type of construction, as indicated in fig. VIII could be employed.

The bottom could be dredged to the required level, the diving bell set, the cylinder foundations cleaned and prepared, and the base or pedestal concreted in the dry in the working chamber. Then after the shifting of bell, the cylinder shell (of steel, wood stave or reinforced concrete) could be set in position on the accurately levelled pedestal, the bottom sealed, the cylinder unwatered, a reinforcing cage placed, and the shell filled in the dry. In this way the cylinder shaft could be proportioned for standard column stresses. The section concreted in the wet would be subjected to suitably lower stresses by reason of its greater area.

Notes re Development

The general principle of the ordinary *diving bell* is old in application. In the construction of quay walls and other harbour works, large bells or caissons have been employed at Marseilles, Antwerp, Genoa and elsewhere in Europe since about 1880. In practically every instance, these caissons were not self-acting, however, but were conducted to place supported between two barges, connected by overhead framing. They were raised and lowered by chains from this frame work.

The self-raising and floating features of the *Halifax bell*, the simplicity of its general construction, the method of ballast control and the great range of depths (20′ to 35′) at which it will work, coupled with its relatively small size in area, make it unique.

In the summer of 1913, while making a preliminary design of the cylinder type, for the wharf faces of the quays and piers of the proposed *Halifax Ocean Terminals*, in order to eliminate the difficulty and hazard of the foundation construction, consequent upon ordinary methods, the writer suggested the employment of a movable caisson or diving bell to place pedestals, in accordance with the scheme of construction outlined above. (See fig. 8.)

In the winter of 1914, James McGregor, A.M.E.I.C., then supt.-engineer for the Halifax Ocean Terminals, in consultation with Jas. E. Taber, at that time in charge of the construction for Foley Bros., Welch, Stewart and Fauquier, the contractors for the dock works, determined upon the adoption of a movable caisson to prepare the foundations for the quay walls, and outlined the size and function of the plant.

The writer took up the detail study and design of the plant and developed the problem as outlined in this paper. The detail drawings were made and the shop drawings checked under his direction and supervision was rendered during construction.

The steel-work was fabricated and erected, and the main structure of the bell completed by the Maritime Bridge Company of New Glasgow, who executed the work very creditably.

Early in 1916, the writer designed a bell, for employment on the Halifax work, over three times the size of the one described. By the use of this larger unit, it was proposed to increase the speed and decrease the cost of the foundation work. The design of this bell embodied a number of improved features of construction and operation, but owing to the increasing cost of steel and difficulty of getting delivery at that time, it was not built.

Discussion

P. A. Freeman, M.E.I.C., gave a vivid description of the funny sensation experienced on going down in the diving bell. From an engineering point of view the Bell was exceedingly interesting, but he would not care to go down again. Captain Spaulding, Port Quartermaster, continued the discussion by relating his experience in the North River tunnel, connecting New York to Jersey, under pressure of about 45 pounds to the square inch. W. P. Morrison, M.E.I.C., asked the author if he would give some details in connection with the air lock of the diving bell. Replying, Mr. MacDonald said that it was impossible to describe the locks thoroughly without detailed drawings. He stated that they consist simply of a length of pipe with a door at each end. The top door is opened and on getting inside the tube one is in a free atmosphere. When the top door is closed the air is admitted from the shaft gradually until the pressure equals the full working pressure in the caisson. The lower door is then opened, which admits to the caisson below. Some of these locks work automatically, and they are now a fairly standard equipment. Asked by Leslie E. Kendall, J.E.I.C., as to what the maximum air pressure was Mr. MacDonald replied that at the 55 foot level it would be the weight of the water, about 64 pounds, multiplied by the depth in feet; hence to get the pressure in pounds per square inch it would always be 64 times the depth in feet, which would give about 27 pounds per square inch at that depth.

Further discussion on this paper was then postponed until a later session.

Fourth Session

9.30 a.m., Thursday, Septemher 12, 1918.

The first paper on the programme for this session was read by the author, H. L. Seymour, A.M.E.I.C., Town Planning Assistant, Housing and Town Planning, Branch commission of conservation on Town Planning in Halifax and Vicinity.

Town Planning in Halifax and Vicinity.

The term "Town Planning" is just as broad as one's vision of the subject. As defined and limited by the excellent legislation enacted in 1915 in the Province of Nova Scotia — known as the Town Planning Act — it means that suitable provision for all future urban and rural development of the province may now be made or effected by the proper authorities.

Contrary to an opinion sometimes expressed, *none* of our Provincial Town Planning Acts — for this is a matter that in Canada comes under provincial and not Federal jurisdiction — contemplate destruction to any extent as a necessary precedent to construction, As a matter of fact, the planning proposed is largely of undeveloped areas, where it is hoped by proper planning to avoid the mistakes of past development; and so far as it relates to developed or built upon areas it seeks to regulate future voluntary reconstruction by the owners rather than make reconstruction compulsory at public expense. Nor is it contemplated under any of the Town Planning Acts that immediate construction should necessarily follow on the preparation of a Town Planning scheme. But what is essentially the object of the Acts is that areas should be planned sufficiently in advance of construction so that any development may be made to conform to the general well thought-out scheme.

F. A. Bowman, M.E.I.C., the worthy president of this Halifax Branch of the Engineering Institute of Canada, could tell you that in the telephone business they have what is termed "a 25 year development plan" for areas served or likely to be served by telephones. From information previously available or collected an estimate is made of the telephone needs for the next twenty-five years in any locality and suitable provision is made therefor. Apply such a principle to all the needs of a community,— replace 25 by oC — and then, gentlemen, you will have reached the ultimate goal of the town planner.

The phraseology of Canadian town planning acts as well as the matter in the Acts themselves is copied largely from the British Housing & Town Planning Act of 1909. For example, Local Authority, Local Board, mean, respectively, the governing body of a city town or municipality and the board or body responsible for carrying out a town planning scheme under a town planning act.

According to the Nova Scotia Town Planning Act every Local Authority shall create a local board, consisting of a Mayor or Warden and two other members of the Council (ex-officio) and not less than two ratepayers to be appointed by the local authority for a term of three years. This town planning board so constituted has wide powers and rather heavy responsibilities. The Act therefore provides that such a local board shall appoint as its town planning engineer, architect, or surveyor, any qualified person who may be the engineer of the local authority, who shall be the executive officer of the board, and who, with the local board, shall be responsible for the carrying out of the provisions of the Act and of the regulations and by-laws issued thereunder by the Commissioner of Public Works and Mines. In Nova Scotia it is to the said Commissioner that all matters in relation to town planning procedure must be submitted for approval.

You will note that town planning engineer, architect, or surveyor, is the terminology of the Act. It is from these three classes, the engineer, architect and surveyor that in Great Britain the Town Planning Institute draws its members, the vice-president of the Institute being the respective Presidents of the British engineering, architectural and surveying organizations. There is a movement in Canada, originating in Ottawa,— and in this the writer is interested — to provide a course of comprehensive studies, which would lead up to examinations open to engineers, architects and surveyors entitling them to style themselves town planning engineers, architects or surveyors, as the case may be. It is also the intention that, for example, the architect should learn enough of engineering and surveying to enable him to intelligently carry out his part of town planning work and

procedure, but it is not intended that he should replace the engineer or surveyor in his function or share of the work. If such a course of studies can be made practicable, it will no doubt attract many professional men to devote some of their spare time to it.

According to the Nova Scotia Town Planning Act, a town planning board must prepare a town planning scheme for lands within its area or else a set of town planning by-laws, the latter method being simpler and less expensive, but not so comprehensive in its scope.

In this province there have, so far, been created but few town planning boards. In the vicinity of Halifax the active Boards are the county of Halifax, the city of Halifax, and by special enactment, the Halifax Relief Commission. Application has now been made or is in course by all three Boards to the Commissioner of Public Works & Mines for authority to prepare town planning schemes. On the key map (See fig. 1) the areas covered by the various schemes are indicated. A certain general procedure has to be carried out in accordance with the "Procedure Regulations of 1915" prescribed under the provisions of the Town Planning Act. Every opportunity is given under these regulations for objections to be made by interested parties. Maps have been prepared for public inspection and public notice of intention to apply for the necessary authority to prepare a scheme has been duly given by newspaper advertisements. Before the schemes are finally approved by the Commissioner of Public Works and Mines, several maps and documents will have been prepared for inspection and filing with the Commissioner and numerous advertisements published. As before mentioned the powers of a town planning board are wide and every opportunity is given for interested parties to file objections before a scheme — which may possibly entail the demolition or alteration of buildings and other changes — is finally approved. It is pertinent to note, application for authority to prepare schemes now having been made, that in any of the areas covered by the application, there can be no compensation obtained by the party who, without the board's permission, now erects any building or makes any improvement that subsequently will have to be altered to conform to any of the schemes. In connection with this question of compensation, for which suitable provision is, of course, made, the Act also provides that the local board can claim half of any increased value which is given to property by the making or alteration of the scheme. Further, and this is perhaps the most important and drastic power given in the Act, property is not deemed to be injuriously affected by reason of the making of any provisions inserted in town planning by-laws or in a town planning scheme, which with a view to securing the amenity of the area affected by the by-laws or included in the scheme or any part thereof, prescribe the space about buildings, or limit the number of buildings to be erected or prescribe the height, character or use of buildings and which the commissioner, having regard to the nature of the situation of the land affected by the provisions, considers reasonable for the purpose.

Town Planning Schemes for the County of Halifax

As shown on the key map (see fig. 1) the approximate extent of the four county schemes is some 18,000 acres.

The large extent of the area comprised in the four schemes and its situation, have made it impracticable to include the whole area in one scheme but all of it is contiguous and when the four schemes are completed they will really be one. And it is proposed to make one set of documents and one set of provisions do for the whole of the four schemes.

The land to be planned is conveniently situated to means of transportation and a large portion of it is likely to be taken up for residential purposes in the near future, both because of its convenient situation in relation to the city of Halifax, and because of the large amount of industrial development which is likely to take place within the county area in the future. The land is peculiarly adapted for securing attractive residential development but in order that this may be protected from undesirable surroundings it is important that it should be controlled under a town planning scheme. A considerable part of the land is not suitable for building purposes but is capable of being attractively laid out for open spaces or agricultural development and should be planned for either purpose.

It is of great importance that the development which is likely to take place in the future should be regulated in such a way as to protect the health of the citizens and to secure the convenience of traffic as well as the preservation, as far as is practicable, of the natural features of this area, wonderfully rich in scenic effects.

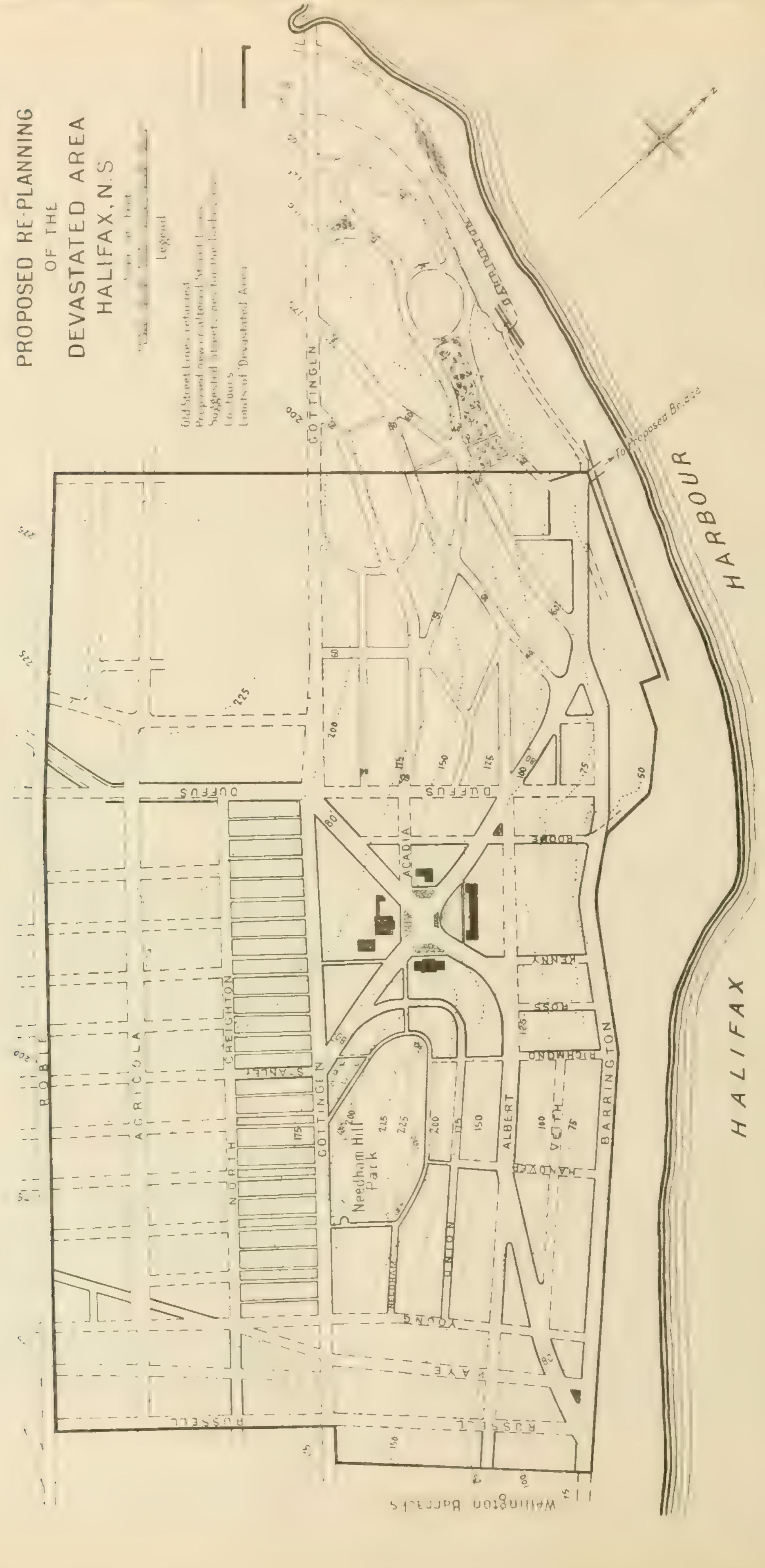
At present there is no extensive system of sewers and watermains, although surveys are provided for small portions of development throughout the area. One object of the schemes will be to plan for the improvement and extension of facilities to enable the future residential development to have proper sanitary conditions.

While a considerable portion of the area is served by highways and streets, certain surveys are necessary in connection with the fixing of main arterial highways and to secure the proper expenditure of provincial contributions for improvement of the highway system. In particular there might be mentioned a change in the locations of the highway immediately to the east of Bedford Basin. At some points this too narrow highway is some distance from the Basin and has a rather difficult gradient. By swinging the road nearer to the Basin the objectionable grade could be avoided and a view of the Basin obtained. The highway thus altered and with increased road width will provide another very attractive motor trip from Halifax to Dartmouth, not only for local motors, but for the visitors that in future should flock to the "Garrison City by the Sea" but which might soon be styled the "Harbour City of Canada."

Town Planning Scheme for the City of Halifax

It will be seen from the key map (see fig. 1) that not all the City of Halifax is included in this scheme of some 2,960 acres. The exceptions are "The Devastated Area," Point Pleasant Park, the Terminal Development Area and the densely built up portion of the city, for the re-planning of which last further legislation would probably be required.

As before indicated the scheme has advanced to the stage at which the town planning board is in a position to prevent undesirable developments, but the details and provisions of the schemes are yet in course of preparation.


PROPOSED RE-PLANNING
OF THE
DEVASTATED AREA
HALIFAX, N.S
Legend
HALIFAX
HARBOUR
To Proposed Bridge
BARRINGTON
GOTTINGEN
ROBIE
AGRICOLA
NORTH CREIGHTON
DUFFUS
ACADIA
KENNY
ROSS
RICHMOND
ALBERT
VEITH
UNION
YOUNG
RUSSELL
Needham Hill Park
Wellington Barracks

There are one or two desirable changes in the city plan that might be referred to in a general way here.

When the terminals are completed some relief for the congestion of traffic on Barrington and Hollis streets is evidently imperative. A diagonal running north westerly from the new station to connect with Brunswick street produced southerly has been suggested.

The production of Brunswick street northerly through Wellington Barracks property to meet the southerly production of Russell street has as you know, also been considered.

If Connaught Avenue, now paralleling the new railway cutting in the southern part of Halifax is connected to Lady Hammond Road, near St. John Cemetery, a desirable drive around the city will be provided. In this connection it is fortunate that the railway approach through the residential portion of Halifax to the terminals is a cutting and not an embankment or at street grade. If the approach is electrified and planting carried out along the cuttings, possible objections to such an approach are minimized. Further, the opportunity has been provided for J. J. MacDonald, a member of this Institute, under the direction of Major James MacGregor, now overseas, to design for us some really delightful concrete highway bridges — particularly delightful, having regard to the very inartistic structures of this nature one sometimes sees.

The changing of the railway terminals from the north to the south end will again affect the character of more than one city area. The term again is used because one can still see how the high class residential area of Halifax of some fifty years ago was altered and influenced in its development by the erection of the North street station with all the attendant traffic activities in that vicinity. The residential area in the south end is now to be altered in character by the new terminal developments. If ideally planned a city might escape these changes, which under ordinary conditions are, however, inevitable. But under a town planning scheme such changes can be controlled. The change for example from a residential area to a commercial area can be retarded until the time comes when it can be rapidly and not lingerly effected. There will thus be avoided " the intermediate slump in property which often occurs between the period when it has a high residential value and the subsequent period when it attains a high commercial value."

The question, why is a city, is one worthy of your consideration. If you decide the *raison d'être* to be a commercial one then such changes as those caused by the terminal developments cannot be objected to only on the ground that residential property is adversely affected. But how might all difficulties have been avoided if the present developments had been planned for sufficiently in advance! In the past most of our towns have been planned or rather allowed to grow without the slightest pretense to a comprehensive survey of the actual existing conditions and without the slightest endeavour to determine future possibilities.

If the proposed consolidation of scattered military properties in Halifax can be effected, it will evidently be greatly to the advantage of both the city and the military authorities.

Major F. W. W. Doane, M.E.I.C., city engineer of Halifax, has also been appointed engineer to the local town planning board. It will be under Major Doane's direction that any changes in the city plan are made.

Town Planning Scheme for the Devastated Area

Pursuant to section 38 of the Act to Incorporate the Halifax Relief Commission, 1918, the "Devastated Area" as now defined by public notice covers an area of some 325 acres (see fig. 1.)

As an effect of the disaster of December 6th, 1917, the land in this area is to a large extent clear of buildings; such buildings as previously existed between that portion bounded by Wellington Barracks on the south and Gottingen street on the west, having been in nearly all cases totally destroyed by the explosion.

The destruction of the buildings, however, does not clear the ground of encumbrances affecting the preparation of a plan. Because of the existence of a large number of small ownerships, and of constructed streets, sewers and water mains in certain parts, it is impracticable to prepare a plan *de novo* as could be done in the case of virgin territory. Regard has to be paid to the existing ownerships and conditions, and to the necessity in the interests of economy, of avoiding any departure from the existing plan which cannot be justified on the ground of real utility and general convenience.

It is difficult to conceive any plan which could be more inconvenient to the public and expensive to the city, than the rectangular plan, which had been followed in this area before the disaster. A rectangular lay-out on a hillside rising from a level of about 50 ft. above ordnance datum taken at its lowest point to about 200 feet at Gottingen Street, and causing grades of over 10 per cent in the principal streets is bad and wasteful in every day. One of the chief defects of the old lay-out is evidently the absence of any streets connecting Barrington and Gottingen streets, a reasonably easy grade.

The revised street plan (see fig. 2) while generally approved by the Relief Commission is subject to alteration and should be regarded as a tentative one. The objects that have been sought in preparing such a plan and the suggested means of carrying them out are as follows:—

1. More direct access in a north westerly direction at an easy grade from Barrington street at its southern end, nearest to the city, by a diagonal route to Gottingen street. A new road 80 feet wide from Barrington, near the corner of Russell to the corner of Duffus and Gottingen has been located from careful surveys and is now staked out. The finished grades up to the Central Square shown on the plan will not exceed in any case five per cent. From the Square to Gottingen street the grade, following the natural ground surface, is 6.5 per cent.

2. More direct access in a south easterly direction from Barrington street, near to the point where it will connect with any bridge that may be constructed over the Narrows, to Gottingen street.

It is probable that any bridge erected across the Narrows will occupy a position somewhat similar

to that of the old bridge long since destroyed by tidal action. A new diagonal route 80 feet wide has been located from a point that will provide suitable access to such a bridge, thence southerly to the corner of Stanley and Gottingen with grades not exceeding 5.5 per cent.

3. Extension of Albert street to the extreme southerly boundary so as to insure the linking up of this street with the ultimate continuation of Brunswick street, when it is extended through the property of Wellington Barracks; thus making Albert street a through thoroughfare from the centre of the city.

To accomplish these objects Albert street is to be widened to 60 feet, where at present it is only 40 feet, and as shown on the plan it is to connect with the new diagonal near Hanover street intersection.

It was hoped that Albert street might also be continued northerly through the devasted area as a through thoroughfare but unfortunately grades of over 10 per cent are encountered on this street as laid out, the rectangular lay-out in this instance providing undesirable grades not only on east and west streets but also on a north and south street. Traffic along Albert street, however, will naturally be taken care of by the main diagonal system and there is a choice of routes in the northerly portion of the area.

4. Laying out of curved streets in areas not already sub-divided or built upon, so as to get easy grades and convenient building sites and link up with the rectangular development already carried out.

These streets are located in what is known as the glebe lands and the co-operation of the owners will be sought in putting any proposal into effect.

In places this area is timbered and rough. The street lines were first approximately located from inspection and from information shown on a five foot interval contour map. Then having established a few control points with transit and level, the location, to save time and avoid cutting, was carried out with compass, tape and clinomoter or Kand Level. You are no doubt familiar with the advantages of this little instrument and know the rapidity with which profiling and cross-section can be accomplished therewith. As to accuracy, the best result obtained was in the determination of elevations every 100 feet, between two points of known elevations and at a distance of 1,900 feet apart. From a reduction of the vertical angles read by the clinomoter, the error in this total distance was only 0.6 feet in elevation. This was, of course, well within the limits of accuracy required for the purpose. Probably an error of one foot in elevation in every 500 feet of horizontal distance might reasonably be expected. But with occasional control points this degree of accuracy is sufficient for street location work of this nature. In connection with suitable control points, it is of interest to all engineers to know that Noel Ogilvie, M.E.I.C., Superintendent of the Geodetic Survey of Canada, was here recently in connection with the work of establishing geodetic points in this province. Of two of the several points to be established in the city of Halifax, one is to be located on the Citadel and one on old Fort Needham.

5. Provision for a central location for the erection of public buildings.

The junction of the two diagonal roads at Acadia street forms a central square with sides of some two hundred and ninety feet and provides a suitable location for the erection of schools, churches, library, etc.

6. Preservation of existing paved streets, sewers and water mains as far as possible.

None of the utilities above mentioned will be adversely affected by the new street plan to any appreciable extent, for example, Kenny street, between Acadia and Gottingen streets, which was macadamized and served with sewer and water main, is now only to be retained as a lane 16 feet in width, but nearly all the metalled part of the street is preserved and the utilities mentioned are included within the limits of the said lane.

7. Increase of the industrial area between Barrington street and water front, as far as practicable consistent with maintaining the convenience and directness of Barrington street.

It is proposed that Barrington street be widened to 80 feet and diverted at Roome street (see fig. 2) to secure the addition of as much land as possible to the industrial site on the north east of the road, adjoining the railways and water front.

Width of Streets

The Tramway Company's tracks are now laid to the corner of Roome and Barrington streets and it is proposed that these should eventually be laid along the new Barrington street out to the square near the site of the proposed bridge. The tram cars when returning would then proceed up to the diagonal leading to Gottingen street, thus providing an added reason for the width of 80 feet advised for this main diagonal street.

While wide main streets are advocated in certain instances for traffic reasons and for the acceleration to desirable developments that wide planted highways provide, many streets on the other hand need not be more than 40 feet wide. Any greater width having regard to their grades and length represents waste.

Open Spaces

On the old plan there were open spaces comprising Mulgrave Park and the public square to the west of the park, having a total area of over five acres. It is proposed that these be abandoned and absorbed in the building area, being in good position for building purposes.

For the purpose of open space other than streets, and paved areas, Fort Needham with an area of over eight acres has been acquired by the Relief Commission for a public park.

This is conveniently situated for the southern section of the area planned and occupies the highest land in the vicinity (lying at an elevation of from 180 to 225 feet above ordnance datum) with remarkably beautiful views. It is unsuitable for building purposes, owing to its steep approaches.

Building Lines

In general it is proposed to adopt a building line on all streets, where lots are 100 feet deep or over, of not less than 15 feet from the street line. For shallow lots the set-back might be reduced 3 feet for every 10 feet of reduction in the depth of the lot. A scale compiled in accordance with this rule, is as follows:

Lot	100 ft.	deep —	set-back	15	ft.
"	90	"	"	12	"
"	80	"	"	9	"
"	70	"	"	6	"
"	60	"	"	3	"
"	50	"	"	nil	

To this scale exceptions can be made, more especially on wide streets and where proper architectural treatment is given to the building.

Character of Buildings

In the preparation of a town planning scheme for this area there should be a limitation placed on the height, character and use of buildings and also on the number which should be erected to the acre or other land unit so that the expenditure which is to be incurred by the Relief Commission in improving the devastated portion of the city will not be incurred in vain. As previously pointed out, it is possible under the Town Planning Act to impose restrictions on the use of the property without any liability for compensation in connection with such limitation.

The Relief Commission have been fortunate in securing the services of the widely known firm of Ross & McDonald, as architects. With the exception of a comparatively few scattered buildings, the whole attention of a large staff of architects under the immediate office direction of Mr. R. H. Dowswell, A.R.I.B.A., has been directed for some months on a housing development for the area immediately west of Gottingen street and extending from Young to Duffus streets. While it is hoped to have altogether some 500 homes ready for occupation by the 1st of January 1919, in the area mentioned provision for 326 families is being made. It is expected that by the fall there will be here 88 buildings completed, this number being made up of 19 six-family terraces, 37 four-family terraces and 32 two-family flats.

The four-family and six-family type are provided with from 5 to 6 rooms, with kitchen or kitchenette and bath. The accommodation of the two family flat type is from 5 to 7 rooms with bath. Fig. 3 is a perspective drawn by Mr. A. R. Cornwell, A.R.I.B.A., of one of the four family terrace types, as shown, all buildings are set back 15 feet and face on a grass court with an intervening 20 foot driveway; a service lane is provided in the rear of the buildings.

These 88 buildings will have outside and party walls of hydro-stone, which is a patented building material made of properly proportioned concrete, and subjected to great pressure in a special power operated machine.

The contract now let for the construction of these modernly equipped terraces and flats brings the cost to about $3,000.00 per family, while the frame dwelling, which are being separately erected, are costing from $2,300.00 to $3,500.00.

Mr. T. Sherman Rogers, K.C., Chairman of the Halifax Relief Commission, has spared no personal endeavor to hasten all development in the devastated area, but it is evident that immediate housing facilities is the most pressing need of the hour. Due to labour shortage, it may be that it will be impossible to carry out much development east of Gottingen street this season, but the writer is firmly convinced that this area is shortly to become a first class residential portion of the city of Halifax.

Discussion.

President Vaughan: "Gentlemen, you have heard Mr. Seymour's paper, which certainly opens up an interesting subject. One's first impulse, I think, in connection with town planning is to wonder whether the regular rectangular scheme is after all not the easiest one, but there is no doubt that the work of our town planning engineers is going to lead to more picturesque and attractive cities in the future than have obtained in the past under the happy-go-lucky methods followed.

" I think we should all be pleased at the way in which the town planning department of the Commission of Conservation is recognizing the engineers and endeavouring to obtain their assistance. From time to time we have had some little differences about town planning, chiefly because there was a feeling that the town planning people were trying to take the work from the engineering profession and absorb it all themselves; but I think that our differences are now pretty well cleared up, and I really feel that Mr. Adams and his assistants wish to encourage the engineer, the architect and the surveyor to co-operate with them in carrying out the work. We feel that we have an organized profession, especially adapted for this kind of work, whose experience is at the disposal of the town planning boards.

" The terrible catastrophe which you had in Halifax affords an opportunity for town planning work that is really going to improve the city and help you get away in some respects from the unpicturesque and congested condition you were getting into. You Halifax gentlemen are no doubt much better acquainted with the local conditions than we visiting members, and I am sure Mr. Seymour will be glad to answer any questions or reply to any discussion which may arise on this paper he has so ably presented."

Asked by C. C. Kirby, A.M.E.I.C., as to what extent the town planning scheme had been definitely settled, whether it had been finally approved and what measures were open for subsequent changes, and what were the property owners' rights to compensation, the author replied, referring first to compensation, that the Act had been planned so that after the application has been made for authority to prepare a scheme and all the prescribed steps in the process duly taken, then if anything that contravenes the scheme is carried out by any owner he is not entitled to any compensation. The necessity for that is apparent if the town planning work was to be properly effected, because between the time the application is put in and the time the application is granted and the scheme prepared, a great deal of development might be carried out which would be entirely foreign to the scheme. Before this application is put in there is a certain procedure required, advertisement has to be made of the intention to apply for the application and a map is submitted for exhibit; and anyone having any objections of any nature to the inclusion of certain areas can present their views, and their objections must be taken note of. Any property owner who might be adversely affected can make his objection and his appeal lies with the commissioner of Public Works and Mines, who, in this province, is the minister under whose department the regulations and procedures are carried out. The various procedures under the town planning scheme are rather confusing to the layman, and it takes a long time to put it through, but at every stage an opportunity is given for objections to be made, and these must be heard. But if a man, after all these chances, goes ahead and makes some development on his property not approved by the town planning board it seems only reasonable that he should have no compensation.

It is provided that the scheme can be altered in the same way in which it was made.

Asked as to how the town planning would affect the poor man, the author replied that in general the object of town planning is now largely directed towards benefiting the poor man particularly. The result of proper town planning would be that the working man would be able to have a home with all modern sanitary conveniences at a rate which should not exceed what he is at present paying for some of the miserable tenement houses he is forced to live in. It is not a function of the Town Planning Board to assist in building and keeping the home up to the standard required. Regarding the width of streets; if the main thoroughfares were of sufficient width the smaller streets could be made narrower without any congestion of traffic.

Gilbert Murdoch, A.M.E.I.C., requested information as to what arrangement had been made between the government and the city in rebuilding the devastated area. Who is paying the bills for these new houses and for the services of the experts and all other incidental costs? No doubt this area was owned by a large number of individual property owners. Are these new houses being built by the city or the government, or are they to be given over to the original owners? In replying to these questions the author stated that the housing scheme was being carried out, as would be seen during the drive in the afternoon and which was shown on a perspective plan in the hands of those present, on land expropriated by the Relief Commission with money furnished from the Dominion Government and from various other sources to provide suitable housing for three hundred and twenty-six families who were rendered homeless by the explosion. It was intended to rent or sell the homes to them, and was primarily intended to provided homes for those rendered homeless. Taking the case of a man who lost his house by the explosion, an appraisal was made of the property as it stood before December 6th, and he is allowed that much out of the relief fund to compensate him for his loss. The majority of these owners are asking the Commission to build their houses for them, as the Commission could do so about fifty per cent cheaper than could the individual. In some cases the houses are costing more than the appraisal, the extra cost being financed by mortgages where necessary. Adding to the discussion on this point, Geo. Ross said:

"As an illustration take the instance of a man whose property loss is $3,000. He may have had a building twenty years old which all of us know could not be restored to-day for that sum of money. He goes before the Commission or before the architects of the Commission, and they deal with his requirements. He wants a certain number of rooms, etc. They find his new building is going to cost $4,000. He then goes before the Commission. Naturally his point is, " I had a home on the fifth of December, and all I am asking is that I should be restored what I had." The answer of the Commission is that certain sums of money have been subscribed for relief, and according to their estimates this amount of money will not entirely meet the losses of the individual owners. Therefore, they are only able to give him a proportion of the amount of his loss. However, they point out that he is going to get a new house for an old

house, and ask him whether he will either allow them to loan him the difference in the cost or take out a personal mortgage which the Commission will accept. So that a man goes before the Commission and is restored with a new house for an old house, and has the same accommodation that he had before with greatly improved conditions. Where a man has certain means, and the Commission think he is able to put something into his new home he is asked to do so. It is a question of dealing with the individul case in each instance."

F. H. McKechnie, A.M.E.I.C., was dubious regarding the town planning schemes in general assisting the poor man without a special fund being provided. The garden cities of England were, he thought, paid for by the large manufacturing concerns to help their employees. This brought out the point that the question raised was essentially an economic and sociological one, and dealt with the question of getting rid of poverty. Town planning would not do that, but it would greatly help by providing suitable housing. Land developed in a haphazard way usually results in poor dwellings. The rentals charged for old tenements would enable the tenant to secure a much better house under the new conditions in the majority of cases because speculative values were eliminated.

Further discussion in connection with town planning acts in Nova Scotia and New Brunswick brought out the fact that in New Brunswick it was clearly set forth that before the scheme could be adopted, it must receive the consent of the public, while in the Nova Scotia Act there was no such provision. The Nova Scotia Act provides, as passed in 1915, that within three years a town planning board would be appointed in every municipality, consisting of the mayor, the warden of the municipality, two councillors, and two other ratepayers of that area. This had not been carried out on account of the war, but it would undoubtedly, when the war is over, be made effective, so that every municipality would have a town planning board and adopt a set of model town planning by-laws drawn up by the Commissioner of Public Works and Mines.

A question by Major Goodspeed, M.E.I.C., as to whether the town planning scheme controlled what a man should do with his property brought out the information that under the scheme adopted such was the case. For instance, supposing a large part of the town is prescribed in the scheme as a residential area, no one is allowed to build factories or other undesirable buildings in that district. Also, buildings could not be built on the street line but at a prescribed distance from the street; thus town planning was in the best interests of the town in general.

D. A. Robb, M.E.I.C., expressed his hearty approval of the town planning scheme and of the advantages to be derived from it, and asked if the expense of town planning was to be borne by the Provincial Government. He was informed that the expense was not necessarily large, being placed at about $5,000.00 for the preparation of a town planning scheme, and the cost was to be borne by the municipality. The Nova Scotia Act provided that the town planning board may receive from the municipality one-twentieth of one per cent of the property assessment for preparing a scheme. If the municipality is adopting by-laws only the cost is also borne by the municipality, and it not to exceed one-fiftieth of one per cent of the assessable value. The by-laws are made by the Commissioner of Public Works and Mines, and do not require nearly the amount of procedure and are not as comprehensive as a scheme.

The discussion was concluded by President Vaughan, who said, "Gentlemen, this movement is a movement the engineering bodies ought to back up. I do not believe there is any doubt that, in general, schemes of town planning properly carried out are going to improve our living conditions and the appearance of our cities; it should be vastly better than the haphazard way we have of doing things at present. As I understand it, the town planning scheme will put certain restrictions on the number of houses per acre, or , as Mr. Seymour puts it, per unit: this will prevent a man buying up a little section of land and exploiting it to his own advantage from a commercial and financial standpoint. It is going to cause him not perhaps to get the full value out of the property but a value commensurate with decent housing conditions. If there are fewer houses to the acre it will have the effect of forcing the poor man further away from the centre of the city, and this will in turn necessitate better street railway facilities to bring the people to work: the people are going to be housed under much healthier and much better living conditions than prevail in so many cities, like Montreal, for instance, where the housing conditions are a disgrace to the rest of Canada as well as to the city itself. Then the rich man is benefited also, his property cannot be spoiled by having a glue factory stuck next door to his house. The general public come in also, because if town planning is sucessfully carried out we should obtain attractive and agreeable residential districts instead of the ugly, rectangular arrangements so common to-day in our cities. Take Toronto, for instance, and look at the number of agreeable and pretty residential districts they have, not as a result of a town planning board but as the result of some successful town planning handled by the civic authorities. You are struck by the difference between the residential districts in Toronto and those in other cities of Canada where no foresight was exercised and where streets were simply strung along and cut up into blocks.

If we want comfortable and beautiful cities we have got to look forward to the work being handled with some amount of foresight, scientific planning and engineering skill. So that we engineers ought to back up this town planning movement in Canada to the best of our ability as engineers who want to assist the public in getting scientific, instead of haphazard, methods."

At the conclusion of the discussion of town planning, C. C. Kirby, A.M.E.I.C., division engineer, Canadian Pacific Railway, St. John, read his paper on

St. John Railway Terminals.

The Railway Terminals of St. John present an interesting problem in regard to their future extension to meet the development of the port. The present terminal layouts are the result of slow growth from small beginnings, and, consequently, the growth has been along the line of least resistance and low cost rather than with the fulfillment of a pre-arranged plan. In this respect St. John is probably no different from most other ancient cities. The high ground surrounding the harbour on four out of its five sides prevents considerable difficulty towards obtaining ideal layouts, or even barely possible working conditions.

The city is now served by two main lines of single track railway. The Canadian Pacific enters from the west and the Canadian Government from the east. The distance from Montreal to St. John via C. P. R. is 477 miles; by Canadian Government Railway via Intercolonial and Transcontinental 702 miles. The distance from Winnipeg to St. John by C. P. R. is 1,884 miles and by Canadian Government Railway is 1,906 miles.

At present the terminals consist of the West St. John facilities, owned by the C. P. R., and the city facilities, owned by the Canadian Government Railways. The distance between West St. John and Long Wharf is 5.6 miles.

The C. P. R. terminal includes a small yard of about 100 cars working capacity at Fairville, at which point all West St. John export freight leaves the main line and follows a short branch line into Bay Shore yard. Bay Shore is the terminal for freight trains from the west. It has a working capacity of about 800 cars and is equipped with a 12 stall engine house and the usual engine terminal facilities of coal plant, ashpit, water tank, etc. It is a turn-around point only for freight engines running between St. John and McAdam, the latter being the maintaining station.

From Bay Shore yard cars are handled to the West St. John docks by yard engine service. There are three main line tracks connecting the two yards operated under the control of a general yardmaster in charge of both yards. The distance between the two yard offices is 1.71 miles. At West St. Jobn the working yard capacity is about 1,000 cars, including cars actually set up along sheds and wharves.

The ocean wharves are at present ten in number, known as berths 1 to 7 inclusive and 14, 15 and 16. In addition there are a few wharves served by the railway which are exclusively used for local or coast traffic.

At St. John both railways do the work themselves of delivering and receiving freight into and out of the wharf sheds. There is no harbour commission or terminal railway company operating here as at other ports.

The ownership of the wharves and sheds lies between the railways, the city, and the Dominion Government. On the west side the city owns sheds 1 to 6, the Government owns No. 6 extension and sheds 7, 14, 15 and 16. The C. P. R. owns the grain elevators and about one half of the conveyor galleries and the Dominion Government owns the other half. The railway tracks are owned by the C. P. R. except alongside of certain of the Government owned sheds, where the Government owns the tracks also. The city owns and maintains the trestle supports upon which the tracks are carried alongside of the city sheds. On the city side of the harbour the Canadian Government Railways owns the ocean terminal sheds at Long Wharf and the grain elevator and conveyor at Reed's Point, but the city owns the shed at the latter point.

The Canadian Government Railway Terminals lie wholly on the city side of the present harbour and comprise two ocean berths at Long Wharf, a passenger station and local yard at Mill Street, a coach yard at Gilbert's Lane, and engine terminal at Island Yard, also a belt line of railway running around the city proper along the harbour front. The belt line serves a number of industries and small wharves used for coast traffic as well as the new grain elevator at Reed's point.

The layout of the St. John Harbour can best be described as similar to the letter "Y," the city proper lying in the crotch of the St. John River estuary and Courtenay Bay. The West St. John ocean terminals lie on the western side of the stem of the "Y" and the Canadian Government Railway ocean terminals are proposed to be built in future along the sides of the eastern arm. The present Canadian Government Railway ocean wharves lie near the head of the western arm on the inner side. The Canadian Government Railway passenger and freight terminal yards lie across the city at the head of the two arms of the "Y" and connect with the C. P. R. at the Union Station near Long Wharf.

The fact of there being so many distinct interests involved at present in the operation and maintenance of the railway tracks, wharves, sheds, grain elevators and conveyors, is to some extent a handicap to the proper development of the port, as any continuity of policy is impossible under such conditions. Besides the city and the C. P. R., the Dominion Government is represented by three different departments, Railways, Public Works and Marine and Fisheries. The creation of a harbour commission is now under consideration for the carrying out of certain functions but the complete ownership and control of all facilities by it has not so far been publicly suggested. That such an arrangement would be in the best interest of the port there can be very little doubt; particularly in view of the necessity for the spending of large sums of money in development work in the near future.

At present there are two schemes of development suggested and partially embarked upon. The Courtenay Bay scheme on the east side and West St. John on the west side. Which of these two schemes will be carried to completion first has not apparently been decided upon but as both of them involve radical changes in the railway terminals the consideration of them is of great interest from the railway viewpoint.

The ideal scheme of development is of course one which can be carried out in part from time to time as the increase in traffic warrants. Unfortunately these

conditions do not apply very well in St. John. In both schemes any further development for even one or two berths will involve a very large expenditure on other work other than the actual berths themselves, such as reclamation, channel dredging, and railway development. The latter item itself is so considerable that the railway interests called upon to make the investment should be entitled to be assured of the full completion of the scheme when once embarked upon. For this reason it would appear proper to complete one scheme before becoming very deeply involved in the other.

The West St. John scheme as outlined and agreed upon by the city, the C. P. R. and the Dominion Government in an agreement entered into in the year 1911 includes the further construction of four piers and a retaining wall from the last one to the base of the Negro Point breakwater, giving eight more berths than there are at present. The area between the site of the piers and the shore is to be filled in and used for railway purposes to serve the piers. The construction of the piers and retaining wall is an obligation upon the Dominion Government as is also the filling in of the area behind the piers for a distance of 400 feet from the end wall of the basins. The filling in of the remaining area is an obligation upon the C. P. R. So far two berths have been constructed by a piecemeal process of construction of one berth at a time and these berths have been reached by the railway company by extending out from its original location. The tracks to these berths approach in a fan shape from directly behind. These tracks fan out from the base of a very heavy grade down from Bay Shore yard and sharp curvature. Unfortunately any further extension of these tracks by fanning out to reach more of the new piers will not be possible on account of the grade and curvature. The construction of the next pier will therefore necessitate a radical rearrangement of trackage. This rearrangement cannot be carried without the reclamation of area between the new piers and the shore and the construction of the retaining walls to protect the filling. When this has been done the railway yard will require to be built at right angles to its present direction and a new entrance to it to be built at wharf level around Fort Dufferin point. This entrance could not be reached from the present Bay Shore yard as the latter lies 66 feet above dock level and too close at hand to make grades. Bay Shore yard would therefore have to be abandoned as the terminal yard and a new terminal constructed at some point further back. A site for such a terminal could be found just west of the Fairville yard, but this would mean the retention of a long 1% up-grade against traffic from the west. A line diversion from South Bay towards Duck Cove with a terminal yard on the flats in that vicinity would appear to be the best arrangement.

The present capacity of West St. John Docks is approximately 250 cars of export freight per day. The final scheme would give a capacity of about 500 carloads per day, exported, or 100% increase.

In discussing railway terminals the operation of grain elevators at St. John cannot be overlooked. The port is now well equipped with elevator capacity but only certain of the berths are equipped with conveyors to deliver grain. During the past season about sixteen million bushels of grain were shipped from West St. John through the conveyors and three and one half million bushels of oats were handled through the elevators and loaded into bags and shipped through the sheds. The elevators at West St. John are owned by the C. P. R. and consist of one timber structure built orginally in 1892 and extended in 1898, having a present capacity of about 600,000 bushels, and one concrete structure built in 1912 of one million bushels capacity. There are 5,280 lin. feet of grain conveyor galleries in use to deliver grain at six berths. The longest run for grain is 2.950 feet when delivered to No. 6 shed from the new elevator. The old timber elevator is operated with rope transmission drives, driven by a 450 H.P. steam engine and the conveyor belts in galleries to berths 1, 2, 3 and 4 are similarly driven. The new concrete elevator is operated by electricity generated from a steam turbine plant in a power house close by. The generating units are two 600 H.P. turbines and boiler plant of four 125 H.P. boilers. Only one half the capacity of generating plant and boilers is generally used, the other half being held as spare. The condensing water for the turbines is obtained by pumping sea water from a nearby basin with an electrically driven 8″ centrifugal pump. The two elevators are operated in conjunction with one another and are connected together with two 36″ belts. The operation of both houses is under one general foreman and grain can be delivered from the new house at any one of the six grain berths and from the old house it can be delivered at four of the berths. An extension of the grain conveyor galleries to the new berths 14 and 15 is now under consideration by the Dominion Government.

On the city side of the harbour a new half million bushel concrete elevator has recently been erected by the Canadian Government Railway but has not yet been put into use.

The conveyor systems make the cost of handling grain at St. John very high in comparison with some other ports.

Since the war began the operation of bagging oats has been extensively carried on at West St. John, this is done by elevating the grain into bins and then delivering it through a spout to machines which feed it into bags, the bags are then sown up by hand and loaded into cars and switched around to the wharf sheds.

The design of wharf sheds has a very important bearing on railway terminal layouts. At St. John practically all of the sheds are reached from tracks laid parallel with them. This works out very well where the sheds are sufficiently long to enable enough cars to be set up alongside to keep the unloading gangs employed from one meal hour to another. Unfortunately at all of the older sheds this is not the case and time is lost by having to switch the sheds during working hours. In most cases it takes as much as 45 minutes to pull and set up a shed and unless there happens to be work at some other convenient shed to which the unloading gangs can be sent for that period the men will stand idle, sometimes 60 to 90 men. An alternative layout for short sheds is to place the tracks at right angles to the shed with trucking platforms between every third or fourth track, This increases the trucking distance but with the use of

electric trucks it forms a good layout. This method is not in use at West St. John but is contemplated as a possible future improvement at certain sheds.

The design of shed floor is also another important factor to the terminal railway. At St. John many of the floors are limited to floor loads of 300 pounds per sq. ft., owing to being constructed on joists and beams; this is a considerable handicap in handling freight as the capacity of the shed is much reduced and therefore additional switching is necessary.

At West St. John No. 15 shed is considered to be the best from the point of view of railway working conditions. This shed is 80 feet wide and 700 feet long with a plank floor laid on sills in solid ground. There are three tracks behind this shed, each holding 17 cars along the face of the shed. Only two tracks are used for unloading purposes at the same time. It is never found desirable to truck through more than one empty car. The third track is used for holding the next set up of cars for the face of the shed. No. 16 shed is 90 feet in width and 750 feet long. Although this is an excellent shed in most respects it has the disadvantage of a limit of 300 lbs. per sq. ft. in floor loading capacity. All of the modern sheds are equipped with continuous sliding doors on both sides.

The use of electric trucks for handling freight from cars to shed has been extensively adopted at West St. John. Last winter 26 trucks were in service. It has been found in practice there that an electric truck is economical for use as compared with hand trucking where the trucking distance is over 75 feet. Two sets of trucks are generally necessary owing to the time required to charge them, which is about 6 to 8 hours. A truck will operate for about 12 hours with one charge. A double set of trucks is of course only required when working day and night shifts. An electric truck has approximately three times the capacity of a hand truck. It has also a number of uses such as hauling heavy shipments across the floor of the shed when loaded on dollies.

At St. John only single deck sheds have so far been used for handling freight. The use of double deck sheds would appear to be desirable although the extreme range of tide presents some difficulties. With export freight loaded into the upper floor and import freight into the lower floor it should be quite feasible to handle freight without the use of land cranes and using only the ship's derricks. The freight loaded into the upper floor from cars would be required to be raised by elevators and electrically trucked.

As a rough estimate of unloading export freight from cars it is found at St. John that one car per hour is an average rate with general commodities and an average trucking distance of not more than about 75 feet. One gang of truckers consisting of 6 men and a checker works at each car.

One of the most recent improvements in railway facilities at West St. John is the erection of a twenty thousand gallon conical bottom steel water tank. This tank was erected by the Pittsburgh, Desmoines Steel Company in 1917. The water supply is received at about 60 pounds pressure from the city main and is regulated by a Davis altitude governing valve on the intake main. The tank is provided with a 10″ spout and also a 10″ connection to a water standpipe. Tank is heated by a steam coil supplied from the elevator power house close by. The steam coil and water pipes are enclosed in a six foot diameter steel cylinder underneath the bottom of the tank. This cylinder has not yet been provided with a frost-proof casing outside as is the usual practice and it is not the intention to use one as there is a better chance to keep the steel work properly painted without a casing. No trouble from frost has yet been experienced.

Following the reading of the above paper, Alex. Gray, M.E.I.C., harbour engineer, Department of Public Works, St. John, read his paper, illustrated with numerous lantern slides and maps, which gave those present a vivid description of the subject covered, that of

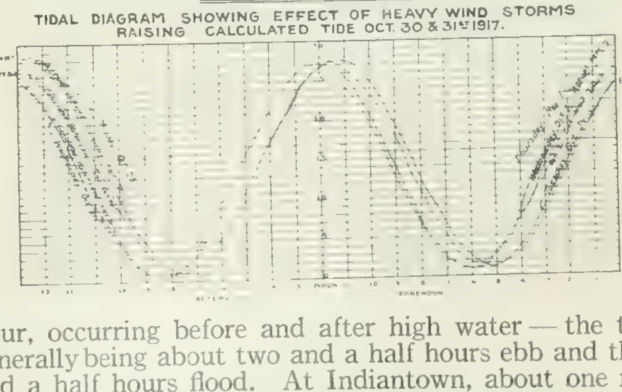
St. John Harbour

St. John Harbour is situated at the estuary of the River St. John, which is about 460 miles long, with a drainage area of 26,000 square miles, and an average flow of about 20,000 c. f. s.

Numerous articles have been published on the tidal phenomena in the Bay of Fundy, and St. John River, but it is unnecessary to deal with these in this paper, further than in so far as they affect the engineering features of harbour development.

The river discharges into the head of the harbour, through a rock gorge about 1,200 feet long and 400 feet wide. The small cross sectional area of the channel does not admit the flood as fast as it rises, or discharge the ebb as fast as it falls into the bay. The minimum summer level of the water surface of the river is 15.0 feet above low water datum of harbour, and the tidal range in the harbour is 13 to 30 feet. The variation of the sea level, therefore, at high water is from 2 to 14 feet higher than the river, thus forming at every tide the Reversing Falls. The extreme high water of the river during spring freshet rises from 10 to 18 feet above the minimum. Navigation between the harbour and the river is only possible for a period of from one-half to one

ST. JOHN HARBOUR.
TIDAL DIAGRAM SHOWING EFFECT OF HEAVY WIND STORMS RAISING CALCULATED TIDE OCT. 30 & 31st 1917.

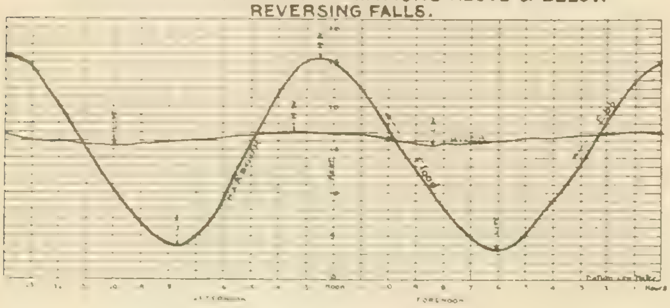


hour, occurring before and after high water — the time generally being about two and a half hours ebb and three and a half hours flood. At Indiantown, about one mile above the Falls, high water occurs about one hour six

minutes, and low water occurs two hours twenty minutes, later than high and low water in the harbour. The average tidal rise at Indiantown, about one-half mile above the Falls, is about 1.3 feet.

The gorge at the head of the harbour, with its submerged reef, forms a slack water reach, which is navigable for small craft from St. John to Fredericton, about 84 miles, and for a total of about 90 miles on several tributaries of the river. This slack water reach acts as a settling basin, in which the heavier silt is precipitated.

TIDAL DIAGRAM SHOWING VARIATIONS ABOVE & BELOW REVERSING FALLS.



The exposure of the harbour is from the southeast to the southwest, while the prevailing winds are from the northwest. The destructive storms however originate in the southeast and southwest and usually afterwards change to the northwest, in which quarter they attain very high velocities. The height of the maximum waves during these storms is about ten feet.

Negro Point Breakwater.
Note shingle accretion on left

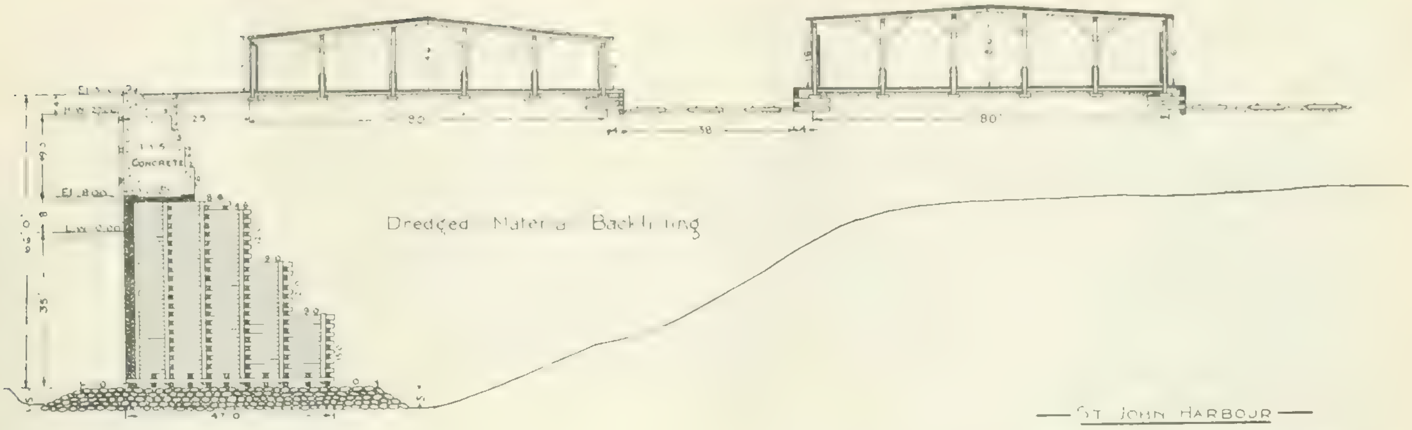
The Negro Point breakwater, 2,250 feet long, is of the rubble mound type, with stones placed at random on the outer slope, weighing 2 to 8 tons, with concrete superstructure for about 946 feet. It was originally designed with a cribwork core, commenced in the spring of 1875 and completed in September 1877. A heavy storm, however, on the 11th and 12th February, 1879, carried away 1,300 feet of the cribwork, to from 10 to 19 feet below high water. From that date to about 1887, work was annually carried on in placing stone to bring the seaward side to a uniform slope of 3 to 1. There is now a concrete superstructure 15 feet wide for a length of 946 feet. The seaward slope at concrete superstructure is 2 to 1. The portion of breakwater, without concrete superstructure, has been raked down by storms to a slope of about 6 to 1, and the crest has been moved towards the harbour about 35 feet off centre line. Around the lighthouse, are placed concrete blocks, weighing 60 to 80 tons each; they are founded a little above low water level. Mr. Shewen, who designed these blocks and the method of construction, arranged the work so that the pouring of concrete was begun as soon as the foundation was dry, and proceeded with at such speed as to keep the top of block above the rising tide — the covering of the casing being pressed down upon a cushion of jute, stuffed with oakum, before the tide rose to the top of the block. After extreme storms, marks on the stones, the disappearance of seaweed from the surfaces, and the displacement of the larger stones indicate the considerable forces exerted. The concrete work in the breakwater is in first class condition, and offers encouragement for concrete in salt water, providing sufficient care is exercised in mixing and placing.

Negro Point Breakwater showing movement at outer end of central line, St. John Harbour

Observations with a marine dynamometer give the force of waves at breakwater a pressure of upwards of 4,000 lbs. per square foot. Part of the concrete work and the dynamometer observations were carried out under the direction of Major E. T. P. Shewen, M.E.I.C., who was for a number of years District Engineer for the Department of Public Works.

Through the opening of about 1,500 feet between the end of the breakwater and Partridge Island, heavy southerly waves break and expand, following the ragged face inside the shore, and continue to roll towards the harbour, causing such extensive erosion of the coast line that protective measure had to be taken in building a revetment wall along the foot of Fort Dufferin.

The principal development in the harbour to date has been on the west side, on which there are at present ten berths, with 32 foot draft, and room for fifteen additional berths as soon as Negro Point breakwater is extended to Partridge Island, and railway facilities re-arranged. On account of the limited frontage, and the railway terminal situation, however, the harbour is being developed from both sides.



— ST JOHN HARBOUR —

— Typical Section of Deep Water Berths 15 & 16 —

WAVE FORCE AT NEGROPOINT BREAKWATER

AS DETERMINED BY E.T.P. SHEWEN, M.E.I.C.

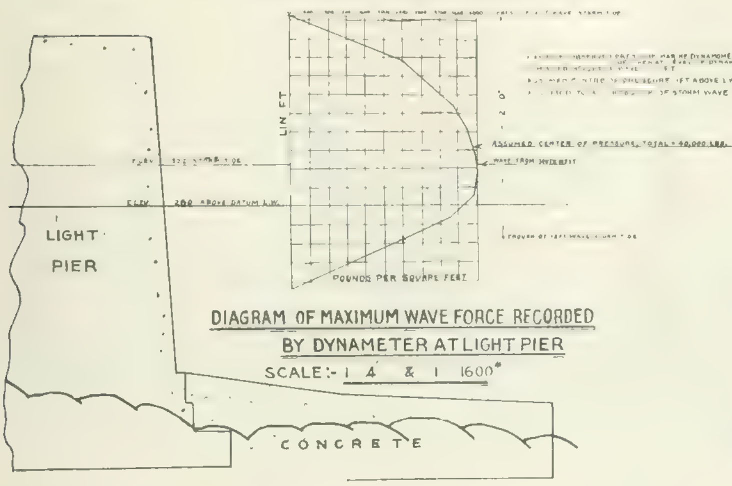
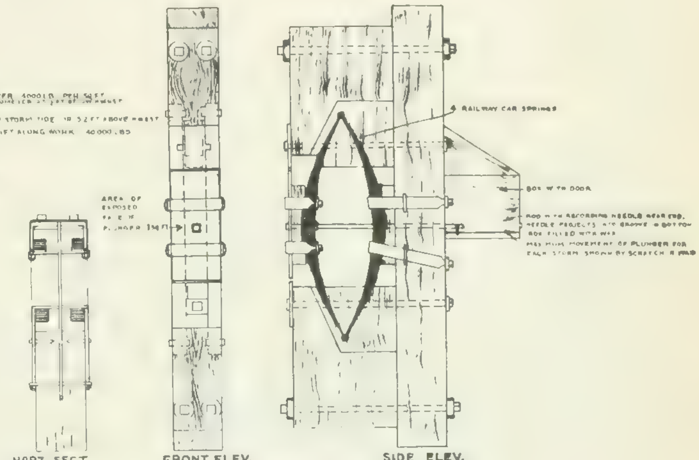


DIAGRAM OF MAXIMUM WAVE FORCE RECORDED BY DYNAMETER AT LIGHT PIER

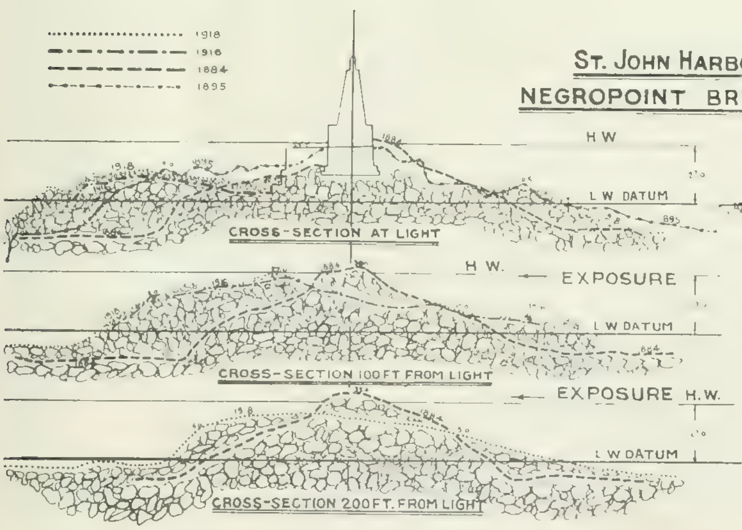
SCALE:- 1 4 & 1 1600#



HORZ SECT. FRONT ELEV. SIDE ELEV.

WAVE FORCE DYNAMOMETER

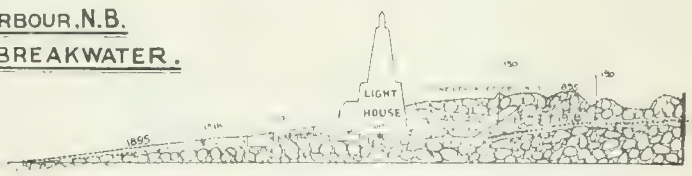
St. John Harbour, N.B.
Negropoint Breakwater.



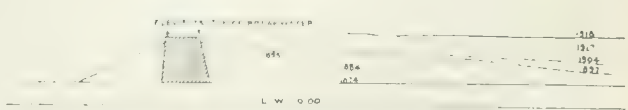
CROSS-SECTION AT LIGHT

CROSS-SECTION 100 FT FROM LIGHT

CROSS-SECTION 200 FT. FROM LIGHT



LONGITUDINAL SECTION AT END OF BREAKWATER



SECTION 400 FT FROM SHORE END OF BREAKWATER SHOWING ACCRETION OF LITTORAL DRIFT.

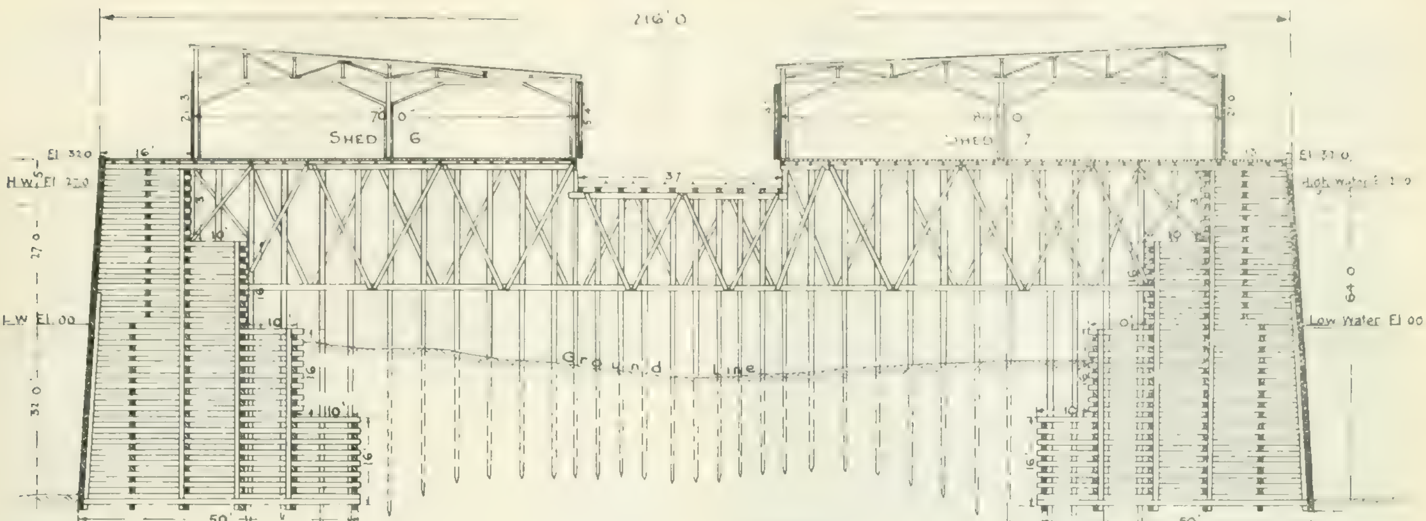
The entrance channel is 12,000 feet in length, and 600 feet in width, and 32 feet clear depth at low water is maintained by annual dredging — the annual siltation varies, but generally amounts to about two feet.

When the Negro Point breakwater is extended to Partridge Island (about 1,500 feet) the littoral drift from the southwest will be arrested, and the flow more concentrated in the channel will increase the scour and assist in maintaining the channel depth.

The materials dredged in the harbour are principally clay, sand, gravel and silt. There is considerable quantity of sumbarine rock to be removed in order to straighten the channel, but on account of the extreme cost of same, this work is being delayed.

During the year, there are generally only two to eight tides below zero, forty 0.5 tides, and sixty 1.5 feet above zero, the remainder of the tidės range from 2.3 to 6.7 feet above zero. Boats generally prefer to berth at slack water — it is, therefore, evident that the channel is navigable for the largest steamers.

The wharves are built to provide 32 feet at low water, The harbour fortunately is free from the toredo, limnora and other sea worms. The type of construction up to the present has been timber cribwork and concrete with cribwork substructure. On account of the scarcity and high cost of timber and the necessary extreme height of the wharves, about 65 feet, other types of structures are being investigated.



—— ST JOHN HARBOUR ——

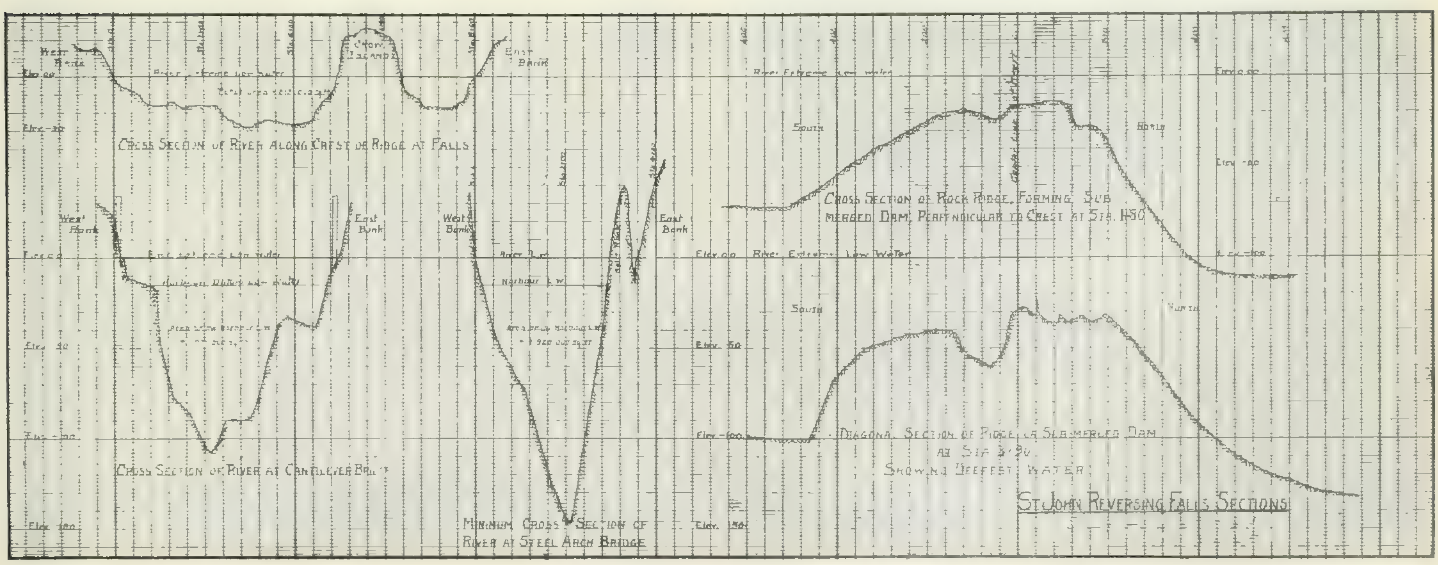
——Typical Section of Deep Water Berths 6 & 7——

The outstanding features in St. John Harbour are the extreme range of tide, and the consequent currents.

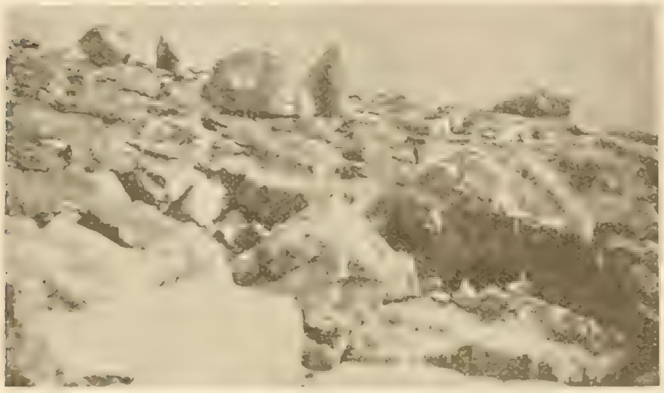
The inward mean tidal flow is about 20,000 c. f. s. and the outward is about 40,000 c. f. s. (The maximum surface current velocity at the minimum section in the harbour is about four miles per hour.)

Unfortunately, no systematic meterings have to date been made of the river, and consequently the river flow is only an estimate. A series of float observations have been taken at various stages of the tide, and at various depths below surface. These show very erratic current conditions. The fresh water from the river flows out, while underneath the tide rises and falls regularly.

The principal wharves are of cribwork with concrete superstructure. The cribs being placed on a prepared dredged bed, covered to an average depth of 5 feet with broken rock. Behind the cribs, selected dredged material is filled in, on which the necessary railway sidings and sheds are built. The sheds are one storey, of timber construction. At a number of the wharves, grain conveyors are built from which boats can be loaded with grain at any stage of the tide. In addition to vertical fenders of 12″ x 12″ hard pine, floating fenders about 36″ diameter and 33 feet long, are placed about 80 foot centres. It may be noted that in berths 15 and 16, which are more exposed to wave action, the life of these floating fenders does not exceed two years.



The Courtenay Bay development, on the east side of the harbour, comprises the building of a dry dock 1,150 feet in length, 125 feet wide, with 40 feet of water on sill at high water, ordinary spring tides, and elevation of sill twelve feet below low water, spring tides; the building of a breakwater 7,070 feet long, of which 4,570 feet have been completed; the dredging of a basin 32

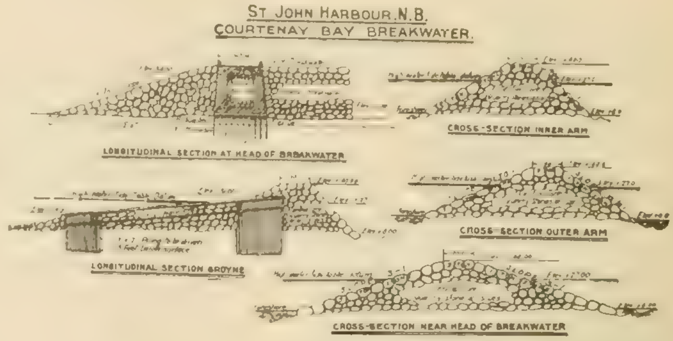


Courtenay Bay Breakwater—Stone 10 to 12 tons moved 50 feet during storm October 1917—St. John Harbour

feet below zero, and channel 22 feet below zero, (zero being extreme mean low water). The details and layout of the wharves have not yet been decided. The breakwater is of the rubble mound type, top width 20 feet, seaward slope varying from two to one to three to one, according to location.

Courtenay Bay Breakwater under Construction—St. John Harbour

The breakwater does not have the exposure of Negro Point breakwater, and it is therefore not expected that the slopes will suffer the raking down experienced at the latter place. The accompanying cut shows stones at the outer end, weighing upwards of 10 tons, lifted from their beds and moved about fifty feet, during a storm in October last. The rock for the breakwater is obtained from the dry dock site, loaded by steam shovels and hauled by locomotive on standard track on trestle, and dumped in the work. At the outer end of the breakwater, where the embankment is wide on account of slopes and depth, two trestles will be used to ensure the larger stones being placed outside.



St. John, on account of geographic situation and consequent long railway haul, to date is principally a winterport. The traffic in 1895 amounted to three and a third million dollars imports, and three million dollars exports, whereas during the year 1917, the traffic amounted to sixteen and three-quarter millions imports, and two hundred million dollars exports.

At the conclusion of the reading of Mr. Gray's paper, President Vaughan announced the meeting open for discussion and called on C. E. W. Dodwell, M.E.I.C., who said:—

Discussion

Mr. Dodwell.— The author of the paper is to be congratulated on his lucid presentation of an interesting and important subject, involving engineering and economic problems of unusual difficulty and magnitude.

To close, or not to close, the Western Channel is a question that has for many years agitated the public mind of St. John, N.B.

Some fifteen or sixteen years ago, at the invitation of the Board of Trade, I went to St. John to give them my views on the question. E. T. P. Shewen, M.E.I.C., at that time District Engineer, Public Works Department, in charge of St. John Harbour, had given the subject long and thorough study and it was his opinion that the proper thing to do was to close the channel by filling the remaining gap of some 1,500 feet, between the south end of the Negro Point breakwater and the north end of Partridge Island, with a subtantial breakwater, even at an estimated cost of about $1,000,000. After very careful consideration of the whole subject, aided by plans and charts showing the depth of water in both the east and west channels, the velocity and direction of the tidal currents, the range of tides and the general configuration of the Harbour, I could come to no other conclusion but that Mr. Shewen was perfectly correct in his conclusion that the west channel should be closed, because:

(1) The increased velocity of current in the east channel at ebb tide, while not sufficient to affect vessels entering the port, would prevent, or tend to prevent,

the deposition of sediment, and thus keep open and maintain an adequate depth in that channel. It should be here pointed out that a fundamental law of Hydromechanics is that the scouring or erosive energy of flowing water varies as the square of its velocity, in other words, if the velocity for instance be doubled the scouring effect is quadrupled.

(2) In times of westerly gales the dangerous and objectionable cross-sea that enters the harbour through the west channel would be entirely stopped.

(3) The sand and gravel that washes through the west channel and gradually reduces the depth of the east channel, would not only be entirely arrested, but it would accumulate on the seaward or western side of the breakwater and in course of years form a natural protective beach.

(4) The east end of the west channel, between it and the east channel, and under the lea of the breakwater, would form a safe and convenient anchorage for schooners and small craft.

(5) A safe and convenient wharf for quarantine purposes, a very pressing need of the port, could be constructed on the northwest end of Partridge Island.

While these conclusions appear to me to be the logical and inevitable result of a careful and unprejudiced consideration of the facts and figures collected with so much care and labour during many years by Mr. Shewen, it is only by their consideration that a sound opinion in the matter can be reached.

The breakwater was begun in 1875 and a length of 2,250 feet, extending southerly from Negro Point towards the north end of Partridge Island, was finished in 1877. It was thought at that time that this partial closing of the west channel would suffice for the protection of the east or main channel from westerly seas, and that the general navigation interests of the port would best be served by leaving open the remaining 1,500 feet of its width.

Owing to frequent damage by heavy seas the breakwater has been repaired and partially rebuilt many times since 1875, the total expenditure by the Department of Public Works since that date being some six or seven hundred thousand dollars.

In response to questions, Mr. Gray stated that the Minister of Public Works told him recently that as soon as money was available the work is to be proceeded with. The cost of building a breakwater to close the passage between Negro Point and Partridge Island will be about $1,000,000.

A. C. Brown, A.M.E.I.C., stated that the paper just read opened a very big question since these Atlantic ports, while of vital interest to the cities at which they are located, are of still more importance to the rest of the Dominion and the development of the coastal ports of Canada should be treated from a national stanpdoint. Heretofore such ports had been built in a more or less haphazard manner and he thought the time had come when a general port planning scheme should be put into effect because in the past much money and energy had been wasted, due to the lack of comprehensive planning. He requested information regarding the best type of breakwater and also the dimensions of the freight sheds. From a study of the question of freight sheds, he thought that a single story shed to handle 10,000 tons should be something like six hundred feet long and one hundred and twenty feet wide for freight alone and if required for passengers would required an additional story. He suggested that an enclosed wet dock with constant level at St. John would be advantageous.

In reply Mr. Gray gave his opinion to the effect that a rubble mound breakwater, after it had been raked down to a uniform slope of about six to one, was the most economical type to build. A concrete structure could be placed on top but the rubble mound should extend to high water at least. The last freight shed erected at St. John is nine hundred feet long by ninety feet wide. Designs have been prepared for two story sheds for the landing of passengers and freight. St. John being a winter port, the climatic conditions would not permit the facile operation of a dock as was suggested.

A. F. Dyer, A.M.E.I.C., asked if the creosoted lumber was used as forms for the concrete and was informed by A. R. Crookshank, A.M.E.I.C., that the work done in 1913 and 1914 was unsheathed and during that winter it showed the need of some protection. The old concrete was covered with the creosoted material but later creosoted lumber was used as forms. Adding further to the discussion, Mr. Dyer stated, that when protecting the concrete of pier 2 at Halifax, the contract called for the concrete to be first coated with cement mortar and then the creosoted material to be placed over it. When the work was commenced it was discovered that the creosoted oil in the lumber had a very bad effect on the cement. Tests were then made using as forms short ends of creosoted plank and it was found when the forms were stripped, the concrete, where it had come in contact with the creosoted plank, had not set and could be rubbed away with one's fingers. If the concrete comes in contact with the creosoted oil before it is set, the cement is killed, but after setting the oil apparently has no effect on it. To overcome this trouble creosoted planks were coated with a heavy coating of pitch which kept the oil away from the cement until it had set sufficiently to be immune. He suggested that possibly the trouble at St. John was due to the green concrete coming in contact with the creosoted oil.

The discussion further developed the fact that the United States Navy Yard had experienced similar trouble and they had aimed to overcome the difficulty by using a very dense concrete so that the effect of the salt water was put to a minimum. The principle reason for sheathing was to protect the concrete from abrasion and from the action of frost and ice, as the frost was apt to split the concrete and cause it to disintegrate and fall away. The creosoted sheathing at St. John had also been coated with pitch to prevent the concrete from coming in contact with the creosote.

C. C. Kirby, A.M.E.I.C., mentioned that a joint meeting such as this should have as one of its objects the interchange of views as to the best methods of construction and design and the experience of the engineers of the two ports, the conditions being similar to a certain extent.

The design of the sheds for harbour terminals is a very important one in its bearing upon railway facilities. For instance, the merits of a double deck shed in distinction to a single deck shed. In the case of the former a vessel's cargo can be loaded into the shed before she arrives enabling the freight to be brought into the port promptly, the unloading of the cars and the releasing of them for service immediately. Thus when the vessel arrives the cargo can be unloaded on to the empty floor and the vessel immediately loaded from the floor carrying the outgoing cargo. This means a great saving in time for a vessel in port and also a great advantage to the railway in the economical use of cars. It also eliminates a certain amount of switching. One of the greatest difficulties experienced is the necessity of bringing freight to the vessel at the exact moment required for the stowage of the cargo, as some of it arrives two months ahead of time and some the day the ship is loading. An enormous amount of trouble is experienced under present conditions in handling the cars and sorting them out in the yards. Thus the question of the design of sheds was an important consideration in determining the future construction of a port.

At this point the meeting adjourned, the discussion being postponed until Friday morning.

Luncheon at Commercial Club

At noon the delegates of the Institute were the guests of the progressive Commercial Club of Halifax at a luncheon at which there were about 150 present, including His Honor the Lieutenant Governor, the chairman on the occasion being F. A. Bowman, M.E.I.C., Chairman of the Halifax Branch. After a few brief speeches on behalf of the campaign for the Patriotic Fund, the chairman called on H. H. Vaughan, President of The Engineering Institute of Canada, as speaker for the day, to give an address. Mr. Vaughan was loudly applauded as he rose to address the gathering, as follows:—

To be asked to tell you, in five minutes, what our Institute is and the objects for which it was formed does not permit of any lengthy explanation.

To tell you what our Institute is and who our members are I cannot do better, I think, than to quote you the requirements in our by-laws for membership. The main qualifications, in addition to a proper education, are that a man must have held a position of professional responsibility or responsible charge in engineering work for a certain number of years, dependent on his grade of membership. In other words, our membership includes practically all the men who undertake professional responsibility or professional charge of the vast amount of work that is being carried on which is generally known as engineering work. They are the men who are responsible for the design and construction of the harbours, docks, water works and sewage works, bridges, railroads, power plants and electrical undertakings, that together make up the engineering work of the country. There are thousands of workers in this field that are not members of our Institute but we represent the men that have the professional responsibility or responsible charge in this work, who are consequently engineers in a different sense to that in which the word is used in the case of locomotive engineers or pile driver engineers and so on.

Now, having tried to tell you who we are, I will try and tell you why an institute of this kind is necessary. Engineering is a peculiar profession in the sense that, while it really requires a technical education and I might say that most of our members are technically educated men, a man's experience as an engineer really commences after his technical education is completed. The science of engineering is in such a constant state of change, such a flow of new discoveries and improvements, that nothing but years of practical experience and the continual exchange of knowledge with his fellows can make a man a competent engineer. The facilities for this work are afforded by the engineering societies and this Institute, which is the national engineering society of Canada, is meeting now at Halifax to carry out a policy we have recently introduced of holding professional meetings in various parts of the country to enable the members to meet and discuss the problems they are particularly interested in, which vary to a certain extent in every district.

To show you how this works I may tell you that this year we have held these professional meetings,— one in Toronto, where the principal subject discussed was the economic treatment of the fuel question, a matter in which, as you know, that district is particularly interested, one at Saskatoon, at which we discussed the problems of road construction in the Prairie Provinces, the effect of alkaline soils on concrete and the problem of a proper water supply for that province, which is, as you probably know, a most serious question. Now, at Halifax, we have discussed the question of the protection of timber in sea-water, the effect of sea-water on concrete structures and methods of dock and harbour construction, which are peculiarly interesting to engineers in this vicinity. You will, therefore, see that we are endeavouring to afford engineers in the various districts of the country an opportunity to come together and exchange information on the subjects in which they are particularly interested and this has been the function of engineering societies from the very beginning.

The first engineering society of them all, the Institution of Civil Engineers in England, has just celebrated its hundredth anniversary and during its life has published over four thousand papers in its Transactions, which have formed a continuous record of the progress made in engineering work during the last century. We are endeavouring in Canada to fill a similar field but, on account of the extent of this country, have found that it is necessary to not only hold meetings in one place but to hold them locally in order to reach the engineers from one end of the country to the other.

This, I think, explains to you the object and aims of our Institute and, on behalf of our members, I wish to thank you gentlemen of the Commercial Club and our other friends in Halifax for the courtesies that have been extended to us during our visit and the hearty welcome that we have received.

Lecture on Quebec Bridge

In the evening representative citizens of Halifax filled the hall of the School for the Blind to take advantage of the opportunity of listening to a lecture, which it has been the privilege of a large number of the members of this Institute to hear, on the building of the Quebec Bridge by George F. Porter, M.E.I.C., F. A. Bowman, M.E.I.C., presided and introduced Mr. Porter as the engineer who was responsible for superintending the construction of this wonderful engineering achievement. Throughout his lecture, Mr. Porter held his audience in rapt attention as they heard explained in nontechnical terms how the difficulties were overcome and the stupendous problems involved were solved. The excellence of the lantern slides in presenting the vivid portrayal of the progress of the work as it developed was the subject of much favorable comment after the lecture. Mr. Porter's remarkable lecture given in an unassuming manner has made friends for him from Victoria to Halifax.

Sixth Session

9.30 a.m., Friday, September 13th, 1918.

Alex. Gray, M.E.I.C., Chairman of St. John Branch, occupied the chair. The Chairman called upon R. H. Smith, A.M.E.I.C., resident engineer Halifax Ocean Terminal Railway to read his paper on the

Railway Construction in Connection with the Halifax Ocean Terminals

The railway approach to the Ocean Terminals commences on the Canadian Government Railway between Fairview and Rockingham, about four miles from the existing Deep Water Terminals. The main line of the Halifax Ocean Terminals Railway will be five miles long and double track.

Terminal Junction yard which was constructed by reclaiming a large and shallow area along the west shore of Bedford Basin for 9,000 feet North from Fairview Station, contains about 16 miles of track for first dock unit. The Pt. Pleasant Terminal yard is partly constructed by excavation and partly by reclaiming inside the walls of docks. This yard including the Grain elevator yard, will contain about 30 miles of track for the first dock unit. The main line passes through the residential section along the North West Arm, but the cutting is of sufficient depth to give the necessary clearance to carry the railway under the bridges carrying the streets and roads.

There are no grade crossings and all streets and roads are carried on ornamental concrete bridges. There are two subways, one at Fairview and one at Pleasant street. The railway is carried under the H. & S. W. Ry.

All culverts are of permanent construction except under yard filling.

Owing to the nature of the rock which varies from a carbonaceous to a silicious state, badly deformed and full of slips and faults, the magnitude of the work, the fact that all the excavation is inside the city limits, and, owing to the railway being practically all in excavation, making it possible to work from both ends only, this work has presented some special features.

The Fairview Cut runs from station 27 to station 80. From stations 80 to 95 there is very light work, and from stations 95 to 116 there is a fill containing about 40,000 cubic yards. Stations 116 to 263 is all in cut. Station 263 is the crossing of Pleasant Street. From Station 263 to the passenger station the railway lines are for the most part on reclaimed ground.

The rock throughout the work was water bearing to the surface and in some cases drill holes were "flowing wells." This made nearly all the blasting of a submarine nature and eliminated the use of black powder in the through cuts. Owing to the water being so cold, dynamite could not be used even in summer weather, and after experimenting with other grades, 60% low freezing forcite was used.

In widening out in the Point Pleasant Terminal yard, that is after the water level had been lowered, "coyotes" were driven and black powder used. The drilling and shooting had always to be kept well in advance of the shovels for economical operation.

Three million, two hundred thousand pounds of explosives were used; and two and one-quarter million cubic yards of material have been blasted. Some of the rock, especially in Fairview cutting, had to be blasted several times.

There has been no loss of life or even accident to employees or the public due to explosives and the property damage done is inconsiderable. This is remarkable when the amount of explosives used, the nature of the rock, the number of missed holes in the early stages of the work, all the work being inside the city limits and the difficulty of keeping sightseers off the right-of-way are all taken into consideration. Everything possible was done to insure safety to the public as well as to employees. Before a shot was fired, men were sent around to warn residents. In the case of aged or sick people automobiles were furnished to take them out of the danger zone, and the contractor's doctor looked after the moving of them when necessary. Men were sent out along all streets and roads to keep the people back; the steam shovels and locomotive blew a series of short blasts of their whistles and allowed sufficient time for everyone to get to cover in case spawls should fly. When shooting along the North West Arm, motor boats were used to patrol and keep boaters out of the danger zone.

The plant was for the most part worked continuously day and night in summer and winter.

Pt. Pleasant breakwater is included in the railway contract.

For the purpose of this paper, I am dividing the work into sections so as to more clearly describe the different methods of construction:—

Fairview Cut.—This cut which was opened in September 1913 proved to be a difficult piece of work. The rock was of slate formation all on edge and water

up to the surface. The slate was in very thin layers full of faults and slips, pockets of rotten rock, and had no regular formation. There was an overburden of composite material including "hardpan" "boulders" and rotten rock. The greatest difficulty was in drilling and shooting. It was found impossible to spring the holes, as the shock of springing caused the holes to cave and they were of course lost. Then it was decided to use all 6″ well drills and place the holes closer together and shoot without springing. A number of spacings were used but none with satisfactory results. Two coyotes were driven and shot but they proved a failure. It was almost impossible to drive the coyotes on account of the water. Even with the well drill holes carried down six feet below grade the bottom was full of "bones" which had to be taken up with piston drills and light shots. During this process the holes were loaded as soon as the drilling was completed in order to avoid losing them. There was a lot of trouble with explosives and at one time about 50% of the holes would miss. A surprising amount of powder was dug out by the shovel, some of which was dead, due to the action of the water. The powder that was alive was shot by adding a couple of fresh sticks and a new exploder. After a lot of experiments by explosive company's experts it was found that the cause of the trouble was the action of the water on the exploders. From then on "waterproof exploders" were used and these for a time did away with "misses."

There is a large flow of water in this cut and it would appear that it will always be "wet."

On February 16th, 1915, the 100 ton Bucyrus steam shovel was cut out and move to Quinpool Road, Fairview cut being to grade but not finished, it being considered advisable to allow the slopes to stand for a while to see how the rock would weather. The finishing was done with a 60 "Marion."

When shot, this rock digs easily, as it breaks small. The water seems to be the life of it.

The amount of explosives used to break this rock was 1.7 lbs. 60% low freezing forcite per cubic yard. The cost was increased owing to the large amount of casing pipe that had to be used on account of caving holes. Some casings had to be driven to grade.

The light cut in the Muskeg Station 31 to 37 was excavated to hard bottom which would be about eight feet below grade and was then backfilled with spawls. This has given very satisfactory results. The excavation was made with a locomotive crane, orange peel bucket and other standard gauge plant.

Terminal Junction Yard.— The material from Fairview Cut was hauled north to Bedford Basin to reclaim for the terminal yard. All existing culverts and sewers have been carried out through the fill in wooden boxes, it not being considered advisable to put in concrete until such time as the full settlement had taken place.

The material from Quinpool Road cut also was all dumped here. The sea slope of the yard is riprapped to protect it from the action of the sea which at times is heavy, and the rock for the rip was taken from Quinpool Road cut. This is a hard rock and there seems to be little likelihood of it weakening through the action of sea or weather.

In the fall of 1915 it became necessary owing to the increased business to get additional storage tracks at Halifax and ten (10) tracks in the most southerly portion of Terminal Junction yard were laid on permanent line and grade. This work was handled in such a manner that the contractors were not interfered with in the grading of the north end of the yard.

In September 1916 the grading was all completed, track work commenced and yard was turned over for operation in December 1916.

There is a storage capacity of 1,600 cars over and above ladders, leads and run around tracks. There is a long lead cutting off the main line at Birch Cove so that trains from north may enter the yard through this lead and reduce main line movement. There are two lead tracks from south end of the yard connecting with main line of Halifax Ocean Terminals and existing main line to Richmond.

The yard is practically level and is proving very satisfactory from an operating point of view. In the south end there are ten (10) storage tracks and in the north end twenty-two (22) storage tracks.

Quinpool Road Cut — Stations 116–20–60.— On November 10th, 1914 a 60 Marion shovel with narrow gauge 3′ 0″ plant started stripping and finished February 23rd, 1915. The cut was stripped from the mouth to station 145. The material from stripping was used to make the main line fill. Station 95–116.

On March 1st, the 100C Bucyrus steam shovel which was moved over from Fairview started digging at grade, station 118 and loading for Terminal Junction yard with a standard gauge outfit. The rock in some places broke large and made the digging slow, but in other places the digging was comparatively good.

The drilling in this cut was done with 6″ diameter electric "Cyclone" drills and all holes were drilled 6 feet below grade and not sprung. Excepting the first 500 feet the rock was fairly easy to drill. There was a varied assortment of rock in this cut, some very soft and some very hard. This made it difficult to judge the amount of explosives to use, as several kinds of rock were encountered in each shot. Some of the pockets of rock were so soft and spongy that the 100 ton steam shovel could almost dig it without shooting.

There was a considerable amount of trouble with the first few shots owing to missed holes. After careful investigation it was found that the exploders were going dead soon after they touched the water. (There was a lot of water in this cut.) The exploders were then dipped in roofing pitch before being used and this eliminated the trouble as all the holes exploded after the exploders were pitched. One hundred holes were shot at a time in four independent series, each series having a separate lead to 220 volt line. Two exploders were put in each hole and each of these connected in a different series. This method reduced the possibility of "misses." The Electric Power Company's current was used for all big shots. Batteries have not been used for shooting on any part of the work since May 1914, excepting for springing and blockholes. The contractors have a power line along the right-of-way from the Electric Company's powerhouse to Fairview. Immediately before firing a big shot the

voltage is tested by the contractor's electrician. When possible to get it, 4″ "forcite" was used in well drill holes as it is easier to handle. The bottom was well broken and only a few "boxes" were encountered excepting between shots.

After the 100C Bucyrus steam shovel started the material all went to Terminal Junction yard. The percentage of explosives used was about 1.0 lbs. of 60% "forcite" to the cubic yard of rock. Casing pipe was driven through the (overburden) and rotten rock.

Cut Coburg Road — South Street.—Some of the worst work on the line was encoutered in this section. The cut is 48 feet deep at the deepest point. The rock is blue in color, hard and full of faults. Owing to the depth it was necessary to take it out in two lifts. Shortly after starting on this cut an injunction restraining the contractors from "shooting in a manner that would throw stones, mud or other missles on adjoining gardens or houses" was placed upon the work.

It will readily be seen that this injunction proved a drawback to the contractors. While spawls only flew from blasts in a few cases previous to the injunction, they were now liable if a few stray spawls got free even if they did no damage. To try and avoid rock flying, all the holes which were 6″ diameter were heavily sprung. This had very disastrous results, for while the holes did not cave, the springing opened up the seams and when the main shots were fired, the rock broke so large that it was almost impossbile to dig it, and it had to be all gone over and plugged.

After the first lift was excavated the shovel moved back and excavated the Quinpool road cut to grade while this cut was being drilled to grade. Electric cyclones were again used and all holes were drilled 6 feet below grade. These holes were shot without springing, and while the result was much better than on the first lift there was a great deal of trouble in excavating, the shovel not making more than 50% of its usual yardage. The nature and formation of the rock and the necessity of light blasting owing to the injunction are principally responsible for this.

The material from this cut was hauled to Terminal Junction yard. Standard gauge plant was used throughout. For a short time a 60 "Marion" shovel was used but it was too light for the work and a 100C "Bucyrus" took its place.

South St. to Bower Road. Station 175–222.— The drilling on this section was all done with 6″ diameter electric well drills. The holes were drilled 6 feet below grade and were shot without springing. The amount of overlay varied. In some places there were several feet and in other places none. Steel casing pipe was used through overlay and rotten rock.

Very little trouble was experienced with the shooting of this section, the contractors profiting by their experience on other sections, but there was considerable difficulty with the drilling. When excavating it was found that the rock was fairly well broken but that the toe on the left (which is the uphill side) broke tight for most of the distance and "toe holes" had to be drilled and shot. The rock was hard and broke large; owing to the dip of the rock some of the shots spilled out to the right or west and lower side but not seriously.

1.0 lbs. of forcite per cubic yard was used to break this rock.

Main Line and Lead Tracks. Stations 222–244. This cut gradually increased in width from 40 feet at subgrade stations 222, to 270 feet at station 244 and decreases in depth from 60 feet at 222 to 45 feet at 244.

In the early part of 1914 one lift 25 feet deep and about 60 feet wide was drilled and shot. From station 236 west the rock was very hard and broke big, causing a lot of delay to the shovels. After the first lot of shooting was done, it was discovered that more explosives were required and the holes would have to be closer together to break the rock satisfactorily, as a lot of the rock already shot had to be blockholed before the shovel could dig it.

After getting down 25 to 30 feet in the cut and so drawing off the water, coyotes were driven to slope on the right or south side to get out to width. These were loaded with black powder and gave good results.

The cut was then all cleaned up and made ready for drilling to grade. 6″ diameter steam cyclone drills started at station 222 and worked east to station 234 and from 234 to Young avenue, steam piston and temple electric drills were used. The holes drilled by steam piston and temple electric drills were six feet below grade and spaced in 6, 7 and 8 foot squares dependent upon the nature of the rock. These holes were all sprung and were thoroughly tamped with sand while being sprung to avoid caving. After each spring this tamping had to be pumped out, making the springing process slow and costly. There were also a number of holes lost in springing. The cyclone holes were 6 feet below grade and were shot without being sprung. The rock in the bottom is harder than on top but nearly all the rock in the cut is hard and breaks large.

From August 1914 to June 1915, most of the material from this cut was hauled to the breakwater. Standard gauge plant and a 100 ton shovel were used on this work. On account of the rock breaking large, there was a lot of rock suitable for rip rap for the sea slopes of the breakwater.

Several methods of drilling have been used. Well drill holes were not sprung but while piston and temple drill holes were, it was proven that even if the rock will stand springing, it is a mistake to do so, owing to opening up the seams and that the best results are obtained from 6″ diameter holes shot without being sprung.

4″ diameter forcite when available was used in all well drill holes. The rock on the south side breaks to a good uniform slope but the north side is full of slips and faults and there was some difficulty in getting regular slopes.

Early in 1916 this cut was widened out to slope on the north side. Coyotes were driven and as the portion of the cut already excavated to grade was shot well below grade these coyotes kept dry. Black powder was used in coyotes with sufficient forcite to explode it. The powder was placed in the coyotes in kegs and these kegs were thoroughly waterproofed with roofing pitch before being used.

This method of shooting gave the best results obtained, but as already noted black powder could not be used in the through cut owing to the water in the rock.

Terminal Yard — Pt. Pleasant Station 244 — Pleasant St.— In April 1914, a hand gang started excavating along Pleasant street from station 263 south to Owen street. On June 1914 this outfit stopped and the 70C shovel started with narrow gauge outfit. Material was first dumped from Owen street north and then along Quay Fill. In August 1914, a 60 Marion started.

In the early stages of this work there was a considerable amount of trouble with drilling and shooting. The bottom was hard to break but this was overcome. Coyotes were driven widening out on the west side, and these gave very good results, as well as being somewhat cheaper than drilling. The rock in this yard is all shaken and on edge, the formation very irregular, very hard to drill and the explosives lost a lot of power in the seams.

As in all other parts of the work there has been a considerable amount of trouble with missed holes, due in most cases to the action of the water on the exploders.

Where the cut is under 30 feet in 6″ depth diameter electric "cyclone" drills were used and these holes were drilled six feet below grade and shot without springing. Where the cut was deeper than 30 feet coyotes were driven. Black powder was used in coyotes and 60% low freezing forcite used in drill holes.

A portion of this yard was finished up in the spring of 1915 and turned over to the dock contractors for their block boulding yard.

Point Pleasant Breakwater.— The breakwater is of a rubble mound type. The core is built of specially selected "run of cut" rock excavated by large 100 ton shovel. From low water to the top it is built of large blocks of rock. The slopes are protected by random rip rap. The blocks of rock used for rip rap vary in weight from two to perhaps thirty tons. The specifications require blocks varying from two to eight tons. The top is paved to a uniform surface. The deepest water encountered was about 65 feet below low water. The finished top is 14.50 above low water and 30 feet wide.

In June 1914 the contractors started hauling a small amount of material to the root of the breakwater and filling in Steel's Pond and along the foreshore to Prince of Wales Cove. On August 15th they had 300 feet of temporary timber trestle completed around the curve on the harbour side and started to dump along this trestle.

After completing the approach curve the dumping was done with a scow and a bridge 40 feet long connecting the scow with the end of dump. The cars were dumped over span and the scow had rails laid on it to make a tail track. The scow 90′ x 40′ x 8′ was fitted with bulkheads and when the tide was high, foot valves were opened and water allowed in, and as the tide went down the water was pumped out.

There was an "A" frame derrick on the scow for lifting the bridge when moving out and the boiler which furnished steam for the pump also supplied the engine that controlled the derrick. This proved a very satisfactory method of dumping, being expeditious, economical and giving a well consolidated fill.

A forty ton McMyler-Interstate standard gauge locomotive crane was being used to load the large stone for rip rap and also to cast same into place. Rocks weighing from 30 to 35 tons have been handled by this crane.

During construction there were a good many heavy storms but no damage was done to the breakwater or the construction plant used.

Shortly after construction was started, it was clearly demonstrated that the breakwater was going to be of great benefit to the harbour. It breaks up the "ground swell" which comes into the harbour part of the time, as well as protecting it against storms from the south and south-east. The design of the breakwater is economical and has proven itself highly satisfactory for the location.

Bridges.— The construction of the permanent bridges was commenced in 1916 and all are now completed.

The Fairview Subway is located at the junction of Bedford Road, Dutch Village Road, Duke of Kent St., Campbell Road and Kempt Road. The railway is carried over the subway on a through girder span with concrete abutments and solid ballast floor.

The railway passes under the existing line of the H. & S. W. Ry. and for the present a temporary timber trestle carries the H. & S. W. Ry.

Bayers Road is carried across the cutting on a single span reinforced concrete arch.

Mumford Road was slightly diverted and passes over the railway on a single span reinforced concrete arch.

Chebucto Road remains at about its original level and the railway passes over it. The railway is carried on through girders with solid concrete floor and mass concrete abutments. The girders and bents are encased in concrete.

Quinpool Road, Prince Arthur Street, Jubilee Road, Coburg Road, South Street, Oakland Road, Belmont Road, Atlantic Street, Robie Street, and Tower Road are carried across the cutting on single span reinforced concrete arches at or near their original grades.

Young Avenue required a two span reinforced concrete arch, as at this point the number of tracks makes a double span necessary.

Pleasant St. Subway will pass under the main line and yard tracks and come out on the new marginal roadway along the bulkheads of the basins and shore ends of piers. The subway will be of reinforced concrete construction and will provide a solid ballast floor for all tracks. This work will not be undertaken at present.

At the present time the permanent yard at the south end terminals is being constructed. There are about twenty-seven (27) miles of track in this yard.

The headblock of yard begins at Bower Road, station 224. There are seven (7) lead tracks besides main line. Yards are so designed that engines can switch in each yard without interference, each yard having two lead tracks. The yard begins below Young Avenue and consists of main receiving and departure yard, pier "A" storage yard and working tracks at various sheds.

North of subway the train shed tracks and coach yard begins. Train shed tracks are on higher level than rest of yard.

No. 1 coach yard which contains eighteen (18) tracks is immediately east of train shed yard and on lower level. No. 2 coach storage yard is to the west of station. No. 1 coach storage yard contains reinforced concrete passenger car repair building and cleaning tracks. Tracks in this yard are equipped with water, air, steam and gas. A loop connecting outside of No. 1 coach storage yard with No. 2 coach storage yard will be constructed and will pass under train shed in subway about 300 feet south of permanent station. The construction of this loop will make it possible to turn complete passenger trains at one time.

In Sept. 1916 it became necessary to construct two temporary sheds, 450′ long by 90′ wide on north wall, basin no. 1. These sheds were built with wood and were completed in December of the same year and have given very satisfactory results.

In the explosion of December 6th, 1917 the railway lost practically all its facilities at Richmond.

Shed on pier No. 9 was completely destroyed.

Pier No. 8 — Both sheds and pier were completely destroyed.

Pier No. 7 was damaged and pier No. 6 completely destroyed,

It took some months to clear the wreckage from the yards.

To handle the business it became necessary to erect sheds at the Ocean Terminals at once and sheds 25 and 28 were built on pier "A." These sheds are of wooden construction, 600′ long by 90′ wide. Sheds and necessary tracks were completed in six weeks.

North street station and train shed were so damaged by the explosion that it became necessary to erect a temporary station at the south end terminals. This work is well under way and it is expected that passenger business will be diverted to the new terminals not later than the first of December of this year.

The temporary station is of wooden construction and built 400 feet south of the permanent station so that when the construction of the permanent station is undertaken there will be no interruptions of traffic.

The contract for the railway grading, bridge and track work is held by the Cook Construction Co. Ltd. & Wheaton Bros., who are represented on the work by Andrew Wheaton.

The temporary station is being constructed by Messrs. Morrison & Downing.

Concrete cars repair building, water and sewer lines are being constructed by the Bate & McMahon, Maritime Company.

Before calling for discussion the Chairman called on G. F. Pearson, representing the Halifax Board of Trade, to give an address. On rising to speak Mr. Pearson was greeted with enthusiasm, and spoke as follows:

" Yesterday, Mr. Saunders, the energetic and indefatigable Secretary of the Halifax Board of Trade, told me that your Institute had placed an address on its programme relating to 'The Double Tracking of the C. G. R.' to be delivered by a member of the Board of Trade. He also informed me that because I had been negligent in my duties as a member of the Council of that body, I was to deliver that address, and it is for that reason I am here. At the outset I want to say quite frankly that I am not competent to and do not propose to enter into a technical discussion of the question at all. I am not going to tell you that the average freight train on this continent averages four miles an hour and that the average steamer averages eight miles an hour, and transports freight at less than half the cost of a railway, for two reasons, first because I do not know that to be so, and secondly some one of you would probably retort that 'Jim' Hill said given a double track railroad alongside of and parallel to a canal he could make lily pads grow in the canal in less than two years. No, I am not going to be led into a discussion of a technical subject with technical men. I know at least enough for that.

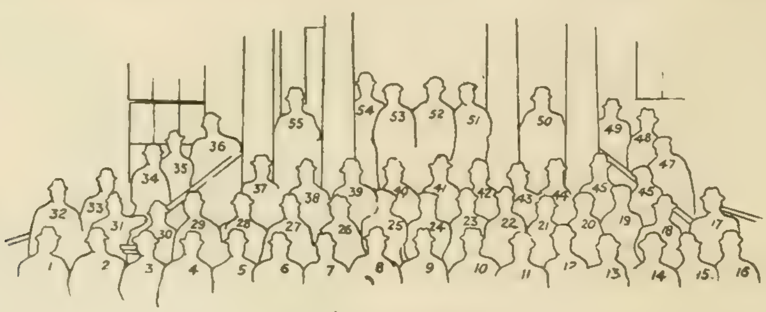
" There are, however, some general reasons why the C.G.R. should be double tracked, which I may venture to suggest to you. In discussing this subject, it is my desire to do so from the standpoint of the Maritime Provinces as a whole and if I happen to mention Halifax particularly, I do so merely by way of concrete illustration. Whatever I may say of Halifax applies to the Maritime Provinces as a whole."

"As I said before, I do not propose to attempt to discuss the technical side of the subject, still, it may be of interest for me to state the viewpoint of an average Maritime Province man with respect to the purposes which these Provinces may be expected to serve.

" Sixteen years before Confederation, in May 1851, Joseph Howe, whom Bluenoses are accustomed to regard as Nova Scotia's most distinguished son, speaking in this city, on the railway question, said: 'We have a magnificent country between Canada and the Pacific presenting to the hand of industry and to the eye of speculation, every variety of soil, climate and resource. The beautiful islands of the Pacific and the growing commerce of the ocean are beyond. Populous China and the rich east are beyond; and the sails of our children's children will reflect as familiarly the sunbeams of the south as they now brave the angry tempests of the north. The Maritime Provinces, which I now address, are but the Atlantic frontage of this boundless and prolific region — the wharves upon which its business will be transacted and beside which its rich argosies are to lie. Nova Scotia is one of these. God has planted your country in the front of this boundless region. See that you comprehend its destiny and resources. See that you discharge with energy and elevation of soul the duties which devolve upon you in virtue of your position.'

" The Maritime Provinces have not, as yet, altogether fulfilled the prophecy of this brilliant gentleman, but in my opinion they are within a measurable distance of doing so. As a Maritime Province man, I like the picture which Howe has drawn of these provinces as the 'long wharf of Canada.' A reference to the map indicates that Nova Scotia in particular juts far out

Third Professional Meeting of The Engineering Institute of Canada, Halifax, September 12th, 1918.



Key to group photograph.

1. Andrew Wheaton, Mgr., Cook Construction Co., Halifax, N.S.; 2. Geo. A. Ross, Ross & McDonald, Montreal; 3. Fraser S. Keith, Secretary, E.I.C., Montreal; 4. A. R. Crookshank, M.E.I.C., Secretary, St. John Branch; 5. K. H. Smith, A.M.E.I.C., Secretary, Halifax Branch, Halifax, N.S.; 6. F. A. Bowman, M.E.I.C., Chairman, Halifax Branch, Halifax, N.S.; 7. Alex. Gray, M.E.I.C., Chairman, St. John Branch, St. John, N.B.; 8. Hon. O. T. Daniels, Ott'y General of Nova Scotia, Halifax, N.S.; 9. H. H. Vaughan, President, E.I.C., Montreal; 10. His Hon. Lieut.-Governor J. McC. Grant; 11. C. E. W. Dodwell, M.E.I.C., Eng. P. W. D. Halifax, N.S.; 12. Mayor Hayes of St. John, N.B.; 13. D. W. Robb, M.E.I.C., Amherst, N.S.; 14. Phil Freeman, M.E.I.C., Gen. Supt., N.S. Tramway & Power Co., Halifax, N.S.; 15. M. K. McQuarrie, M.E.I.C., Kentville, N.S.; 16. Jas. T. Duke, Public Works Dept., St. John, N.B.; 17. Edwin Fraser, M.E.I.C., New Glasgow, N.S.; 18. R. Montgomerie, A.M.E.I.C., Montreal; 19. C. C. Kirby, A.M.E.I.C., Dist. Engr. C.P.R., St. John, N.B.; 20. P. H. Mitchell, A.M.E.I.C., Toronto, Ont.; 21. Geo. F. Porter, M.E.I.C., Montreal; 22. G. Stead, A.M.E.I.C., Chatham, N.B.; 23. G. S. Macdonald, Dist. Engr. Marine & Fisheries, St. John, N.B.; 24. Major F. G. Goodspeed, M.E.I.C., St. John, N.B.; 25. R. J. Sly, Campbellton, N.B.; 26. W. Rodger, A.M.E.I.C., Engr. Halifax Shipbuilding Co., Halifax, N.S.; 27. W. P. Morrisson, M.E.I.C., Engr. P. W. D., Halifax, N.S.; 28. Allan H. Wetmore, Pres., Board of Trade, St. John, N.B.; 29. J. J. Macdonald, A.M.E.I.C., Engr. Halifax Ocean Terminals, Moncton, N.B.; 30. H. B. Pickings, Pickings and Roland, Halifax, N.S.; 31. L. H. Wheaton, A.M.E.I.C., Cook Constr. Co. & Wheaton, Halifax, N.S.; 32. D. L. Hutchison, Meteorological Service, St. John, N.B.; 33. Fred G. McPherson, A.M.E.I.C., Halifax Ocean Terminals, Halifax, N.S.; 34. R. H. Smith, A.M.E.I.C., Res. Engr., Halifax Ocean Terminals, Halifax, N.S.; 35. Frank A. Gillis, Halifax, N.S.; 36. Major Sinclair, Halifax Relief Commission, Halifax, N.S.; 37. Ira P. McNab, Mech. Engr., Nova Scotia Tramways & Power Co., Halifax, N.S.; 38. J. S. Misener, Engr., Acadia Sugar Refineries, Dartmouth, N.S.; 39. O. S. Cox, J.E.I.C., P. W. D., Halifax, N.S.; 40. W. H. Noonan, S.E.I.C., Halifax Ocean Terminals, Halifax, N.S.; 41. B. M. Hill, Provincial Engineer, Prov. of N.B., St. John, N.B.; 42. J. R. Freeman, A.M.E.I.C., P. W. D., Halifax, N.S.; 43. A. J. Barnes, Traffic Mgr., Maritime Telegraph & Telephone Co., Halifax, N.S.; 44. A. C. Brown, A.M.E.I.C., Harbour Engr. Halifax Ocean Terminals, Halifax, N.S.; 45. A. F. Dyer, A.M.E.I.C., Engr., Furness, Withy Co., Halifax, N.S.; 46. F. H. McKechnie, A.M.E.I.C., Halifax, N.S.; 47. G. N. Hatfield, A.M.E.I.C., Road Engr., St. John, N.B.; 48. Geo. G. Hare, A.M.E.I.C., City Engr., St. John, N.B.; 49. G. G. Murdoch, A.M.E.I.C., St. John, N.B.; 50. C. M. Crooks, Maritime Telegraph & Telephone Co., Halifax, N.S.; 51. John P. Mooney, J.E.I.C., St. John, N.B.; 52. H. L. Seymour, A.M.E.I.C., Town Planing Asst., Comm'n of Conservation, Ottawa, Ont.; 53. Leslie E. Kendall, J.E.I.C., Imperial Munitions, New Glasgow, N.S.; 54. C. C. Forward, Chemist, Inland Revenue Dept., Halifax, N.S.; 55. N. F. Cook, Halifax Relief Commission, Halifax, N.S.

into the trade routes of the north Atlantic and is, in fact, a gigantic wharf designed by nature to serve the commerce of the world.

New York and Liverpool are the second and third great shipping ports of the world, and it may be of interest to you to know that Halifax is nearer many of the great centres for procuring raw materials than either of these world-famous ports.

	Miles from Halifax	Miles from New York	Miles from Liverpool
Liverpool	2,450	3,100	....
Barbados	1,900	1,825	3,627
Kingston, Jamaica	1,810	....	4,049
Pernambuco	3,451	3,678	4,065
Rio de Janeiro	4,611	4,748	5,138
Montevideo	5,586	5,723	6,123
Buenos Ayres	5,701	5,838	6,232
Cape Town	6,423	6,786	6,067
Melbourne	10,289 (via Panama)	....	11,015 (via Suez)

Great Britain has grown rich out of her shipping. Before the war, practically half of the ocean going steam tonnage in the world was owned in the British Empire. From the Southern States raw cotton is transported to the mills of Lancastershire, there to be manufactured and shipped perhaps to China for sale. The cane sugar of the West Indies, the rubber of Brazil, the wool of Australia, and the hides of the Argentine follow the same process. Marmalade is made in Dundee from oranges grown in Spain and sugar transported from the West Indies. In every part of the process of transforming raw materials into the finished product and the final delivery to the ultimate consumer, Great Britain plays a part and makes money. She levies proper tribute upon the whole world. Halifax is more favorably situated in point of distance, with respect to all these centres, than is Liverpool. It has a continent behind it to consume the finished product. I have always felt, myself, that it is a misnomer to call the northern Atlantic states "New England." That title more properly belongs to the Maritime Provinces. The resemblance between these provinces and the Mother Country is much closer. The area of the United Kingdom is a little less than two and a half times that of the Maritime Provinces of Canada. In many important respects, their resources are alike. Here we have extensive coal deposits — the only coal deposits on the Atlantic coast of North America. We have an abundant and never-failing fishery. Our agricultural resources are yearly increasing and, proportionately, are greater than those of the United Kingdom. The same is true of our forest wealth. Here then we have an abundance of the four great sources of wealth — farming, fishing, the forest and the mine — which form the basis upon which we should build after the fashion of the Mother Country.

But, you ask me, what has this to do with double-tracking the C. G. R.? To which I answer, of what use is a wharf unless you prepare proper means of access to it from land? I have endeavored to present the reasons why Howe's imagery of the Maritime Provinces as a wharf is borne out by the facts. I have tried to show that these provinces are, in fact, the wharf upon which Canada's overseas business must be carried on.

If you look at the map again, you will see that three lines of railway connect the great hinterland of Canada with Moncton and St. John. Halifax, which may be likened to the end of the wharf, is connected with Moncton by a single line of railway, of which only 21 miles out of a distance of 186 miles are double-tracked. I believe the day is not far distant when all these three lines should be double-tracked from Montreal and Quebec to St. John and Halifax. Nobody, of course, can tell exactly what will happen after this great war is over, but this much I think we can assume, and that is that we cannot go along after the war in the ordinary lackadaisical manner in which we carried on our business before the war. I am strongly in favor of taking everything we can get from the Germans, even to their methods of national organization for business. After the war, we shall have a national debt of over two billions of dollars. Upon this we must pay the interest. Canada may be likened to a great store with the provinces as its departments. We cannot make money as a nation to pay this interest by trading jack-knives between provinces. We must become an exporting nation like Great Britain. We must reach out to the markets of the world and lay tribute upon them for the wares which we have to sell. We must become a ship-building nation; we must earn freights from the rest of the world and bring the gold into Canada to add to our national wealth and help us to pay our debts. I have it on the authority of F. P. Jones, Chairman of Canada's War Board, that we can manufacture in this country the things we are naturally adapted to produce in competition with the United States. "But," said Mr. Jones, "our industrial life must be organized and specialized." If this were done, Canada can lay the whole world under tribute for access to her wares. The Maritime Provinces, as I have pointed out, are the wharf over which this trade must be carried, so it becomes of vital importance to prepare against that time the highways upon which our goods shall roll down to the ocean for export, and complementary to that, we must develop in these Maritime Provinces the manufacture of things which we are adapted to produce in order that they may be carried back to the hinterland in the cars which have brought down our products for export.

Now if the statements I have made are within measurable approximation of what may happen after this war, we must equip our sea ports to take their proper place in the general scheme of things. Halifax and St. John each have certain equipment now. It is clear to any observer that the present port facilities of Halifax have been more than adequate to ship the products which the C. G. R. has been able to carry from Moncton to Halifax over a single line of railway. In other words, delays have occurred by reason of the inadequacy of that single line of railway, In saying this, I am not to be understood as criticizing the operating officials of the C.G.R. They did, I think, exceptionally well with the facilities at their disposal, but those facilities were, and are, inadequate to the business offering. It occurs to me the situation here may be likened to the situation which would occur if the Quebec bridge were said to be

completed with the centre span missing. We have in Halifax good port facilities now. When they are completed, they will be three or four times as great. We have three transcontinental lines running into Moncton, 186 miles from Halifax. The "centre span" requires to be built. In other words, the C. G. R. must be double-tracked. Then, and not till then, will we be able to make adequate and efficient use of the facilities at either end upon which this country has expended so many millions of dollars.

Your Chairman has said that I am the representative of the Halifax Board of Trade. If I do occupy that exalted position, in the name and on behalf of that body, I bid you welcome to Halifax. I trust your stay will be pleasant and your discussions profitable, not alone to yourselves but to our common country. We, all of us, have an important part to play in the upbuilding and development of our country, and it being a new country, you as trained and technical men have, perhaps the more important part to play. I am sure you will play it worthily, and with "energy and elevation of soul.'"

Asked by C. C. Kirby, A.M.E.I.C., as to what promises had been given regarding the double tracking of the Canadian Government Railway from Moncton to Halifax, Mr. Pearson replied that promises had been made by the Federal Government under the rule of both parties and also by the technical staff of the I. C. R., but as to the immediate prospect he had no knowledge. K. H. Smith, A.M.E.I.C., stated that without doubt there had been much delay in the shipping from Halifax by reason of insufficient railway facilities. He believed that all the facts and figures had been secured by the former general manager of the Canadian Government Railways, F. P. Gutelius, M.E.I.C., who had had plans and specifications prepared in respect of double tracking. Continuing the discussion Mr. Pearson believed that it would be well to be prepared in advance for increased business. He mentioned that Boston was discussing the expenditure of seventy million dollars by reason of the fact that increased port facilities were required for war purposes. R. J. Wilson mentioned what was being done in the United States with respect to shipbuilding and increasing shipping facilities. He believed that in Canada with the enormous natural resources we should be alive to the possibilities and prepare shipping facilities in advance which would seem to justify double tracking the Dominion Government Railway from Halifax west.

Mayor Hayes of St. John, who represented the city officially at the convention, when asked to speak, stated that he had been very much pleased to be able to accept the invitation of the Chairman of St. John branch to be present. With the other members attending he had had the pleasure of listening to the splendid lecture on the Quebec Bridge, and on the former afternoon had been with the party inspecting the docks and terminals. A movement had been started to have the Maritime Provinces united, and in order to get recognition both St. John and Halifax should work together. Nothing was to be gained other than by co-operation. He appreciated the courtesy which had been shown him in Halifax by the citizens and by the engineers. He presumed that next year a professional meeting of the Institute would be held in the Maritime Provinces, and cordially invited the members of the Institute to accept the invitation of the City of St. John to hold the Maritime Convention there in 1919.

Mr. Wetmore, Chairman of the Board of Trade of St. John, heartily endorsed the sentiment of Mayor Hayes, and assured the gathering that the Board of Trade of St. John would be glad to co-operate in making the meeting a success, and that the St. John branch could count on the support of the Board of Trade if the members of the Institute saw their way clear to accept the invitation.

On motion by Gilbert Murdock, A.M.E.I.C., seconded by C. O. Foss, M.E.I.C., it was unanimously resolved that this meeting recommend to Council that the next Maritime professional meeting be held in St. John.

The meeting continued with a further discussion regarding the operation of the terminals, after which the discussion on creosoted timber and reinforcing steel and concrete was proceeded with.

Votes of Thanks

President Vaughan complimented the members of the profession in the Maritime provinces on the splendid success of the first professional meeting in the east and assured the members that he had greatly enjoyed his visit in Halifax, and noted with pleasure the enthusiasm which had attended the various sessions. It gave him much pleasure to move the following votes of thanks, all of which were unanimously approved:

To Lieutenant-Governor Grant for his kindness in giving an address of welcome at the opening session and his courtesy in extending an invitation to Government House, where the group photograph was taken, and for being present on the trip through the City of Halifax and on the excursion of inspection of the new plants and terminals.

To the Mayor and citizens of Halifax for their welcome and for the many ways in which they had added to the comfort and pleasure of those at the convention.

To the Officers of the St. John and Halifax branches and particularly the local committees for the tremendous amount of work they had done to make the meeting such a complete success.

To the Press of the City of Halifax for the large amount of space they had devoted to the meeting, and for sending representatives to be present at the various sessions.

To Cook Construction Company, Limited, and Wheaton, for providing the train and transporting the members from the North Street Station over the new tracks through the cut to the new terminal.

To Mayor Hayes and the Chairman Wetmore of the Board of Trade of St. John for attending as official representatives and for their kind invitation to hold the next meeting at St. John.

To the Board of Trade of Halifax, and particularly to Secretary Saunders, for placing the hall of the Board of Trade at the disposal of the Institute for holding the various meetings.

To all who had prepared and read such excellent papers as had been delivered and discussed at the meetings.

On behalf of those present the Chairman thanked President Vaughan for his attendance at the meeting and for the active part he had taken in making the gathering a success.

This brought the final session of the first Maritime professional meeting to a close. All who were present will look forward to attending the next professional meeting because of the information and inspiration received and the opportunity for a better acquaintance and social intercourse which this meeting afforded.

Visits and Excursions

In the afternoon the members met at the Halifax Hotel and divided into groups for the purpose of visiting various points of engineering interest, which included the new Telephone Exchange, The Imperial Oil Company's Works, the Halifax Shipyards, the Nova Scotia Tramway and Power Company's Power House, and one of His Majesty's submarines then in the harbor.

In the evening the delegation from St. John and north left on the eight o'clock train, resolved that they would immediately plan for a similar successful meeting next year.

Notes of Halifax Meeting.

That broad smile on the faces of the executive of the Halifax Branch was due to the fact that the weather they had ordered arrived on schedule time and continued during the convention.

Few Lieutenant-Governors in Canada, if any, would have waited for an hour and a quarter as did Lieutenant-Governor Grant — even for such an important body of men as the members of this Institute. He is a hero in his own home town!

When the Lieutenant-Governor called upon the energetic secretary of the Halifax Branch to make an announcement at the Rotary Club as "Kilowatt Hour Smith" he incidentally paid a tribute to the restless, unceasing energy of an electric circuit.

Those who left the city on Friday missed something. The Secretary advises that as guest of its gallant and deservedly popular President, C. E. W. Dodwell, he spent an afternoon session at the famous Studley Quoit Club, where the traditions of the Club were fully maintained.

The men from St. John found out that the men of Halifax were all right, and a similar opinion was formed by the men in Halifax of the visitors from St. John, which illustrates a direct benefit professional meetings are accomplishing in enabling the members of the Institute to become better acquainted.

Past President Dr. Martin Murphy who is one of the oldest members of the profession in Canada came all the way from Moncton to be present, and many of the members had the pleasure of meeting him for the first time. Though no longer young in years his mind is still keen and his interest in professional affairs as alert as ever.

Those who had the good fortune to spend an hour or so on the inside of a submarine were examining one of the two famous under-water boats of the Canadian Navy, purchased by the late Premier of British Columbia at the beginning of the war. The officer in charge gave information to the effect that they are remarkably good fighting machines.

The Province of New Brunswick recognized the importance of this gathering by sending as its representative, B. H. Hill, provincial highway engineer, who made a splendid delegate and one who would carry back to the Government a report calculated to show members of the Legislative body the importance of the work being done by engineers.

The city of St. John excelled itself. The St. John Branch had already co-operated towards getting up the programme through President Gray and Secretary Crookshank and the executive. The delegates from there constituted a considerable percentage of the members registered. Mayor Hayes and Chairman Wetmore of the Board of Trade, represented the city officially and consequently were in a position to give an official invitation to hold the next professional Maritime meeting in their city. The engineering profession will appreciate the courtesy of the city of St. John in this connection.

Registration Third Professional Meeting, Halifax, September 11th, 12th and 13th.

C. E. W. Dodwell, Halifax; Hiram Donkin, Halifax;; Alex. Gray, St. John; H. H. Vaughan, Montreal; Capt. T. S. Scott, R.C.E., Halifax; A. F. Dyer, Halifax; W. P. Morrison, Dartmouth; J. R. Freeman, Halifax; Gilbert G. Murdoch, St. John; C. C. Kirby, St. John; C. R. Coutlee, Ottawa; Geoffrey Stead, Chatham, N.B.; Major F. G. Goodspeed, St. John; G. G. Hare, St. John; O. S. Cox, Halifax; A. R. Crookshank, St. John; T. M. Schenk, Halifax; A. J. Barnes, Halifax; J. G. Macdonald, Halifax; Phil. A. Freeman, Halifax; L. E. Kendall, New Glasgow; A. C. Brown, Halifax; F. H. McKechnie, Halifax; C. M. Crooks, Halifax; John P. Mooney, St. John; O. S. C. Goodman, Halifax; G. S. Macdonald, St. John; G. N. Hatfield, St. John; R. Hammersley, Campbellton, N.B.; C. H. McClare, Lakelands, Hants, N.S.; H. L. Seymour, Ottawa; J. S. Misener, Dartmouth; Ira P. Macnab, Halifax; F. A. Bowman, Halifax; J. H. Winfield, Halifax; Fraser S. Keith, Montreal; Major R. W. McColough, Halifax; Major J. H. Pringle, Halifax; J. L. Allan, Halifax; G. Ernest Booker, Halifax; K. G. Chisholm, Halifax; K. H. Smith, Halifax; L. H. Wheaton, Halifax; C. W. Archibald, Truro; C. H. Wright, Halifax; Wm. J. DeWolfe, Halifax; Roderick McColl, Halifax; Capt. H. C. Spaulding, Lieut. W. E. Stewart, J. M. Somerville, Ottawa; G. F. Jacobs, Halifax; W. Rodger, Halifax; C. C. Forward, Halifax; J. G. W. Campbell, Dartmouth; R. M. Brown, New York; W. B. MacKay, Halifax; J. W. MacDonald, Halifax; E. F. Hanly, Halifax; R. Montgomerie, New Glasgow; George F. Porter, Montreal; K. R. Chestnut, Halifax; E. L. Philips, Halifax; N. L. Cook, Halifax; H. B. Dibblee, Halifax; J. H. Holiday, Halifax; R. H. Smith, Halifax; James T. Duke, St. John; Geo. A. Ross, Montreal; D. W. Robb, Amherst; C. O. Foss, St. John; D. L. Hutchison, St. John; C. W. Knowles, Halifax; M. K. McQuarrie, Kentville; J. W. Roland, Halifax; F. Anderson, Ottawa; P. H. Mitchell, Toronto; R. T. Hayes, St. John; Allan H. Wetmore, St. John; B. M. Hill, Fredericton; J. G. Dryden, Halifax; E. S. Fraser, New Glasgow; W. Grant, Halifax; W. H. Noonan, Halifax; H. A. Russell, Halifax; J. A. MacKay, Truro; W. A. Hendry, Bedford, N.S.; W. J. Mortimore, Schnectady, N.Y.; H. R. Holder, Halifax; F.W. W. Doane, Halifax; J. P. Bains, Halifax; Chas. A. Hodge, Halifax; M. Murphy, Moncton; R. J. Wilson, Fairfield, Ala.; H. B. Pickings, Halifax.

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Annual Meeting at Ottawa.

Council has given approval to the request of the Ottawa Branch that the annual meeting of the Institute for 1919 be held at the Capital City. The annual meeting will thus coincide with the next professional meeting, towards the success of which the Ontario Branches are already co-operating. A combination of a general professional meeting and the annual meeting should result in the greatest engineering gathering that the profession has yet witnessed. The date will be approved by Council later, but in the meantime, every member should make up his mind that, if at all possible, he will be present at this important engineering conference.

Maritime Professional Meeting.

Halifax's reputation as a convention city and the reputation of its citizens for hospitality have been well maintained in the eyes of the engineering profession at least, judging from the viewpoint of the members from outside points who had the good fortune to attend the third professional meeting of the Institute, which was held in Halifax, September 11th, 12th and 13th. In spite of the fact that the city is still suffering from the shock experienced nine months before, apart from the material evidence of the destruction, no murmur was heard of the suffering that had been experienced. The fact that the men in Halifax were willing to undertake the responsibility of a professional meeting at this time is ample evidence of their pluck. The manner in which the arrangements were made and the details carried out to provide for the comfort and enjoyment of those who came as visitors to the city, bears further tribute to the men who live down by the sea, and who possess a combination of qualities that are admirable.

Halifax in September, nineteen hundred and eighteen saw history made for the engineering profession, saw the first professional meeting of the Institute to be held east of Toronto and for the first time in the history of the Maritime Provinces a convention of engineers from many centres gathered to discuss engineering problems, to get acquainted and establish a basis of friendship that will make impossible misunderstandings in the future. Henceforth co-operation and united effort will dominate the activities of the Maritime members.

From even a brief perusal of the report of this meeting it is obvious that it was a success but to those who were there and took part in and enjoyed the fraternal feeling in evidence it was more than a mere success, it was an achievement of great moment to the profession.

Lieut.-Col. Leonard for President.

In the summary of Council Minutes appearing on another page is given the report of the Nominating Committee for officers and councillors of the Institute for 1919. This report has been approved by Council and its publication in this issue will constitute the official notice to members of the nominations as proposed by the Nominating Committee. Inasmuch as all the men nominated have duly signified their acceptance of their nominations, the report is complete.

A distinct departure takes place this year in the election of councillors, for, under the new By-Laws each district elects its own. As the ballot now stands, Lieut-Col. Leonard becomes President for the coming year. There will be an election for two Vice-Presidents and this ballot will go to all corporate members. For councillors every corporate member in each district will receive a ballot, bearing the names of the nominees in his district only.

The choice of President for next year is a happy one and by giving to the Institute the same ability and energy which have heretofore characterized his attitude towards everything he undertakes, the Institute is assured of a President who will grace the position and who will be the means of accomplishing much for its welfare.

Tobacco Fund.

Following its approval by Council on September 24th to a Tobacco Fund similar to that of last year, the subscription list is now open and the members are once again given the opportunity of duplicating the pleasure received last year in contributing to this, one of the most worthy funds which the Institute has inaugurated. Last year every member Overseas was sent, thanks to the generosity of our members, a parcel of cigarettes and tobacco and the letters of thanks received by the Secretary showed that it was appreciated away and beyond the monetary value which it represented. Some of the letters

received were almost pathetic in their thanks as the boys expressed the feelings experienced when the gift and message were received. Let us remember them again this year even more substantially than before, even though it may mean a small sacrifice on our part, which, after all will be nothing in comparison with those daily experienced by our gallant men over there.

If you are a branch member please send your contribution to your own branch Secretary and if a non resident, it will be gladly received at headquarters. When this issue of the *Journal* is mailed there will be about five weeks in which to make the necessary arrangements and in view of this, would you kindly give this worthy object your attention before finishing reading the *Journal.*

Rules Governing the Award of the Leonard Medal.

The Gold Medal called the Leonard Medal, shall be struck each year and paid for from the annual proceeds of a fund provided for that purpose by Lt.-Col. R. W. Leonard, which medal shall be awarded in accordance with the following rules for papers on mining subjects presented either to the Canadian Mining Institute or to The Engineering Institute of Canada.

1. Competition for the medal shall be open to those who belong to the Canadian Mining Institute or to The Engineering Institute of Canada.

2. Award shall be made not oftener than once a year, and the medal year shall be the year ended June last previous to the year in which the award is made.

3. The medal shall be presented at Annual Meetings of The Engineering Institute of Canada.

4. A committee of five shall judge the papers entered for competition, all of whom shall be members both of the Canadian Mining Institute and The Engineering Institute of Canada, one member of this committee to be the donor or his nominee, and the remaining four to be appointed by the Council of The Engineering Institute of Canada.

5. All papers presented shall be the work of the author or authors and must not have previously been made public, except as part of the literature of the Canadian Mining Institute or The Engineering Institute of Canada.

6. Should the committee not consider the papers presented in any one year of sufficient merit, no award shall be made, but in the following year, or years the committee shall have power to award the accumulated medals or to award a second prize in the nature of a silver medal, or a third prize of books to be selected by the committee.

7. The medal shall be suitably engraved containing the name of The Engineering Institute of Canada, and the words, " The Leonard Medal " together with the adopted design, and on the reverse side the name of the recipient, the date and any other inscription that may be decided upon by the committee.

Approved by Council, July 23rd, 1918.

Canada Represented at Conference.

A high tribute has just been paid Canada as a nation and to the engineering profession in Canada particularly, by being invited to send delegates to the Interallied Aircrafts Commission Conference, being held in London, England, on October 1st. The countries represented at this international gathering are, Italy, France, Great Britain, United States and Canada. Each nation has one vote which gives this country equal standing with the others in relation to the development of the airplane for the present conflict and the place it is to occupy in commerce after the war.

The invitation to send delegates to this Conference was received by the Canadian Engineering Standards Committee, who appointed Capt. R. J. Durley, M.E.I.C., chairman of the airplane section of the Committee to represent this country. Capt. Durley is now in England.

Important Departmental Changes.

In the re-arrangement of functions of several of the Federal departments at Ottawa, changes are being made of great interest to the engineering profession. Until these changes are definitely decided upon and a formal public announcement made, it is not possible to make any predictions with regard to the status of the members of the Institute affected. There is little doubt, however, that with the keen appreciation of the work and importance of the technologist in the Government employ, and the absolute necessity for retaining the services of the experienced and qualified engineers, any changes that will be finally decided upon, must benefit the engineers concerned.

Publicity as an Asset.

Men conversant with the inner working of the affairs of the Allied nations have admitted that the most colossal mistake made in the early days of the war was in prohibiting proper publicity of heroic events that would have thrilled the whole world and added much to the strength of the Allied cause. This surely has been also the great mistake of the engineering profession, the failure to realize that the general public could not be interested in the profession when they were not being made acquainted with the work the profession was doing.

A noted Englishman in the United States recently stated that civilization no longer rides on a gun carriage, but on the printing press, and that the moving force of the world is not steam, not gasoline, not electricity, but PUBLICITY.

It is not enough that we as engineers should know that the engineer has been the responsible, the pivotal figure in the great advance that mankind has achieved in its material progress in the past century, but it is a duty we owe ourselves to educate every man, woman and child to a realization of this fact, to educate them to a point where everyone has a distinct appreciation of how much his or her material comfort in every day existence, depends on what engineers have done and are doing and to think of the engineer in a spirit of thankfulness for the benefits he has conferred on the human race.

Report of Council Meeting.

The regular monthly meeting of Council was held at the rooms of the Institute, on Tuesday, September 24th, at 8.15 p.m.

After the previous minutes had been confirmed, the report of the Executive Committee was presented.

Legislation: It was recommended that inasmuch as the question of legislation having arisen in the various branches and being of the utmost importance to the Institute, a special meeting of Council should be held to go into the whole question and receive the report of the Legislation Committee based on the proposed draft for legislation in Western Canada, in order to advise the western branches and give a sense of direction to any legislation which may be sought.

Place of Annual Meeting: A request from the Ottawa Branch to have the Annual Meeting held in Ottawa this year to coincide with the Ontario Professional Meeting, which had already been approved for Ottawa, was received and considered. It was resolved that the request of the Ottawa Branch be granted. Consequently the Annual Meeting of the Institute for 1919 will not be held at headquarters as in the past.

Engineers and the Militia: The subject of the relation of the engineering profession to the Department of Militia was discussed, based on the recommendations of the Executive that an approved letter be forwarded to the Ottawa Branch outlining the past difficulties in dealing with the Government. It was resolved that the Managing Committee of the Ottawa Branch and the Secretary of the Institute be appointed a Committee to go into the whole question of the relation of the engineering profession to the Military Department and to report to Council their recommendations regarding the best methods of approaching the Government.

C. V. Corless' plan for Education: It was expected that further information on this question would come before Council as a result of a meeting recently held in Ottawa, but as no communication had been received from any of those present, although the Institute was officially represented, it was decided to ask for a report to be read at the next meeting of Council.

Technical Literature: The kind offer of the American Society of Civil Engineers to allow the Institute to publish in the *Journal*, current engineering articles of interest was noted, and the Secretary was instructed to acknowledge Dr. Charles Warren Hunt's letter extending the thanks of Council in this connection. Inasmuch as this offer had been received through the activities of H. R. Safford, the thanks of Council were extended to him also.

Western Professional Meeting: A request from two branches in the west having been received that the next western professional meeting be held in each of these respective centres, it was decided that the western branches be advised to agree on a place of meeting for the professional meeting in 1919 and having reached a unanimous choice of place to submit same to Council for approval.

Nominating Committee: The report of the Nominating Committee submitted by the chairman, W. F. Tye, was received and adopted and the Secretary instructed to deal with same in accordance with the by-laws. It was intended that a publication herewith of the report of the Nominating Committee shall serve the requirements of the by-laws that all members be notified.

President: Lt.-Col. R. W. Leonard, St. Catharines, Ont.

Vice Presidents: Walter J. Francis, Montreal; A. E. Doucet, Quebec; D. H. McDougall, New Glasgow, N.S.; D. O. Lewis, Victoria, B.C.

Councillors:

District No. 1. Arthur Surveyer, Montreal; P. B. Motley, Montreal; K. B. Thornton, Montreal; Sir Alex. Bertram, Montreal.

District No. 2. A. B. Normandin, Quebec, Que.; J. E. Gibault, Quebec, Que.

District No. 3. Alexander Gray, St. John, N.B.; A. R. Crookshank, St. John, N.B.

District No. 4. G. G. Gale, Ottawa, Ont.; Professor E. A. Stone, Kingston, Ont.

District No. 5. E. W. Oliver, Toronto, Ont.; W. A. McLean, Toronto, Ont.

District No. 6. W. G. Chace, Winnipeg, Man.; W. P. Brereton, Winnipeg, Man.

District No. 7. G. D. Mackie, Moose Jaw, Sask.; J. N. deStein, Regina, Sask.

District No. 8. A. T. Fraser, Edmonton, Alta.; L. B. Elliot, Edmonton, Alta.

District No. 9. R. W. Macintyre, Victoria, B.C.; H. E. C. Carry, Vancouver, B.C.

One year Vacancies in Council

District No. 7. Professor A. R. Greig, Saskatoon, Sask.; H. G. Phillips, Regina, Sask.

District No. 8. F. H. Peters, Calgary, Alta.; A. S. Dawson, Calgary, Alta.

The written consent has been received from all of the above.

Exemption of Taxes: This question has come up from time to time in the past and Council recently instructed the Legislation Committee to get a definite legal opinion as to the status of the Institute in this connection. In a letter from Arthur Surveyer, chairman of the Legislation Committee, he quoted the opinion of Aime Geoffrion, K. C., as follows:

"The Article 362 of the Charter of the City of Montreal describes the properties which are to be exempted from the yearly taxations. The sections ' b,' 'd ' and 'e' are the only ones upon which a plea might be based to secure this exemption. These clauses read as follows:

(b) The lands and buildings recognized as educational institutions by the Council of Public Education or subsidized by the Catholic Schools' Commissioners or the Protestant Shcools' Commissioners of the City.

(d) The lands and buildings exclusively occupied and utilized as libraries, reading rooms, art galleries or public museums, provided they are free to the public and not kept in order to maintain a lottery.

(e) The lands and buildings exclusively occupied and utilized as establishments of higher education or scientific teaching regularly constituted in corporation or recognized by the government.

As according to the explanation you have given me, the property of the Canadian Society of Civil Engineers, cannot be classed in any one of the classes defined by these three clauses, I am of the opinion that the Society has not the right to ask such an exemption."

Attitude on Railway Problem: A letter was read from one of our members, suggesting that Council take action regarding the railway situation and go on record with a view to advising the Government as to the Institute's stand on this important question. It was resolved that no such action should be taken particularly since the Institute had endorsed that masterly paper on the subject by W. F. Tye and the reception Mr. Tye's paper received from the Government did not warrant any further expense and labor on the part of the Institute at the present time.

New Certificate : The report of the Committee on the new certificate signed by H. R. Safford, Walter J. Francis, and Ernest Brown, was approved. The report was adopted and the design submitted was approved, it being intended that the name title of the certificate be adopted as part of the design and wording to appear on the stationery of the Institute. As soon as an ink copy of the new certificate is made it will be reproduced in the *Journal.*

Membership Card: The report of the Committee appointed to discuss the question of a membership card was adopted, to the effect that no such card be issued at the present time. This report reads:

Your Committee, appointed for the purpose of considering a new form of Membership Certificate, likewise was requested to look into the matter of the use of an identification card. The Committee, after full consideration, reached the following conclusion:—

The reasons which call for cards indicating memberships in various organizations, generally fraternal in character, or in the nature of business clubs, do not seem to exist in a professional body like the Institute. It is so rare that a member of a professional body will attempt to misrepresent himself regarding membership and there being practically no advantage that would result from such action before his true identity could be determined, that there would seem to be no necessity from this standpoint.

It may be argued that an identification card would be an introduction for a member visiting similar bodies in the United States and other countries, but it is not felt that the welcome would be any more cordial than would be given by a man introducing himself or wearing a badge. It is felt that the professional standing of engineers precludes a requirement of this kind.

H. R. Safford continued as Councillor: The following letter from Mr. Safford was read by the Secretary:

On September 1st I will take up the duties of my new position as engineering assistant to the regional director of the Central Western District, United States Railroad Administration, with headquarters at Chicago, which, of course, will require my permanent residence at that point.

It would seem necessary that I should relinquish my office as Councillor because I will be unable, of course, on account of geographical location, to be of much value in assisting to direct the affairs of the Institute and I believe, therefore, I should tender my resignation as Councillor, effective at the pleasure of the Council.

I assure you that it is with a great deal of regret that I feel obliged to take this action, because one of the most pleasant associations in connection with my residence in Montreal, has been with Institute work, although I feel that I have been a very small factor in it because my duties prevented me from being a very active member of the Council.

I have no thought, of course, of severing my connection with the Institute and my membership will always be one of my most cherished possessions.

Any service that I can ever render to the Institute in my new capacity will be a great pleasure.

Will you be good enough, therefore, to present this as my resignation as Councillor, and oblige.

As an expression of the esteem with which Mr. Safford is held by Council and in recognition of the excellent work he had done both as a Councillor, as chairman of the Library and House Committee, and as an active member of various other Committees, it was decided that Mr. Safford's resignation be not accepted but that he be continued as a member of Council during the remainder of his term. Considerable regret was expressed that Mr. Safford's new work has taken him out of active participation in Institute affairs.

Society of Chemical Industry: A request from the local branch of the Society of Chemical Industry to hold their meetings once a month in the assembly hall of the Institute was presented, and the Secretary was instructed to write the Secretary of the Society of Chemical Industry advising them that Council is pleased to grant their request and that the President and Secretary be authorized to conclude arrangements.

Town Planning: The correspondence from the Ottawa Branch was discussed and the Secretary instructed to advise Ottawa Branch that Council is of the opinion that the question of town planning is one that concerns engineers vitally and one that is of interest to the Institute, therefore the Ottawa Branch is requested to make constructive suggestions to Council before Council comes to a decision regarding a plan of action.

Ontario Provincial Division: A letter from J. B. Challies, Secretary of the Ottawa Branch, advising that James White, John Murphy and A. A. Dion had been appointed to represent that branch on the Nominating Committee for the organization of a Provincial Division for the Province of Ontario was read and the Secretary was instructed to advise these members of their appointment and also to notify the other branches, with the suggestion that Toronto and Hamilton branches also appoint committees and that they co-operate with the view to establishing a Division and making arrangements for the election of officers, being assured of any required co-operation from headquarters.

Tobacco Fund: Hearty endorsation was given to the proposal that a tobacco fund similar to that of last year be established and the Secretary was instructed to proceed with arrangements whereby our overseas members would receive cigarettes and tobacco as a Christmas remembrance from the Institute.

Classifications were made for a ballot returnable October 22nd.

CORRESPONDENCE

Preservation of Timber

Editor, *Journal*,

In connection with Mr. Dodwell's paper on "The Preservation of Timber," I would like to give an account of an inspection of creosoted timber at Long Island City N. Y., together with some remarks on the specification, which might be of interest to the Institute in considering this subject.

The timber inspected was ready for creosoting and was of full size and amount and of good quality, only a few sticks being condemned.

I went thoroughly over the creosoting plant, traced out the many lines of piping, for steam, creosote, &c., noted the position of the various valves, gauges, thermometers, &c., and their uses and looked into the method of measuring the creosote and the treatment generally. I also had an analysis made of the creosote or dead oil of coal tar and followed the operation and the determination of the amount of the distillates. The analysis showed that the proportion of naphthaline contained in the oil was satisfactory.

The plant is an old one and the working tank and part of the piping is underground making it difficult for an inspector to follow the course of the creosote, &c., and to ascertain independently the amount of creosote used. I understand that in more modern plants conditions in these respects have been much improved.

The company have had their working tank measured by a company making tank measurements a specialty, who have prepared a table of the quantity of creosote contained for every inch in the height of the tank. The creosote is maintained at a depth of about five to seven feet in the tank and between these depths the quantity per inch varies very little. Its average is taken in figuring the actual difference in the height of the floating gauge which must result from the injection of the specified quantity of creosote in any given quantity of timber.

The loading of timber on the trucks and insertion in the tanks was continued on the 4th December and treatment began at 1.15 p.m. on that day and was continued successively in the three cylinders which held the charge up to 12.30 p.m. on the 5th. I was therefore unable to follow the process for every cylinder but from the gauge readings saw that the full amount of creosote required was injected.

A week later I again visited the works and inspected the creosoted timber which was then hauled out of the cylinders into the yard, sawed one stick in two and took a number of borings to satisfy myself as to the penetration.

The average and general penetration was good and the more open grained sap wood was thoroughly impregnated. Where however dense heart wood was close to the outside faces the penetration, as I have found in previous lots of creosoted timber which we have received, was slight varying from ⅛ to 1 inch.

The 14 pound treatment is insufficient to fully impregnate the whole body of the timber and the more open grained wood therefore necessarily takes the bulk of the oil leaving the heart wood but slightly penetrated. To obviate this difficulty would require the specification of a larger quantity of oil per cubic foot and a longer treatment. Another method might however be used, viz. to inject additional oil under a long treatment and finally recover the excess of oil by pumping under a vacuum. Either method would be expensive and it is a question whether in any case a full penetration of the heart wood is practicable.

In use the creosoted timber is more exposed on one side than the other and is in general well impregnated on one side at least, and so far as our experience goes the 14 pound treatment though involving the above objection in regard to the heart wood has been found to give satisfactory results.

The creosote used in the treatment inspected contained 4 ½% of water or considerably more than the amount called for in the specification which was ¾ of 1%. The creosoting company therefore injected an additional 4 ½% of creosote to make up for the water present, as it would not have been practicable for them to empty their tanks and obtain a special supply.

The company's manager stated that the oil was purchased on a 3% basis as to water contained but that the percentage varied from 0.5 to 6.0% which I verified by looking through the analysis of various lots of oil received and he stated that this is the condition of the oil in this respect as furnished generally by the manufacturers.

I would suggest that 6% be made the maximum allowance in the specification but that when it exceeds 1 ½% additional creosote be injected to make up for the full water content.

The presence of 6% of water in the oil, the extreme amount, can have very little effect in the treatment because it would amount to only 1.3% of the volume of the wood which is a small fraction of the water which remains in ordinary seasoned wood, and probably less than the water which remains after the steaming process. It is also negligible compared with the water which must be absorbed by the wood when used in sea works.

My attention was called to several points in the specification for creosoted timber used by the department when tenders were asked for this material in 1912.

In the paragraph headed "Process or Treatment" the steaming process is to be conducted under a pressure of 35 to 55 pounds per square inch with a temperature not exceeding 275° F., but a pressure of 55 pounds recorded on the steam gauge would mean a temperature of steam of about 302° which is too high. 25 to 35 pounds on the gauge would give the temperature desired—266° to 280° F.

Further—not less than 23 inches should be specified for the vacuum, which is attained by any good vacuum pump, and the temperature in the cylinders during the exhaust should be specified as being maintained above the boiling point of water corresponding to the inches of vacuum. The temperature given in the specification 100° to 130° would allow condensation of the water vapour at vacuums of less than 28″.

I might say that every facility required was allowed me for the inspection of the treatment and that the employees of the company gave up considerable time in going into all the details of the process and plant with me and in giving me all the information asked for.

In connection with the many timber wharves built by the Public Works Department in New Brunswick we have a continual expense through the repair of decayed plank covering and stringers.

In 1910 on the wharf built at Moncton before laying the plank we covered the stringers with 2 thicknesses of tar-paper cut in strips slightly wider than the stringers. The expense of this was slight and the results are good judging from an examination lately made, for although the covering is worn and decayed and requires renewal the stringers so far as we examined them were quite sound.

Geoffrey Stead,
A.M.E.I.C.

* * *

A Simple Method to Obtain the True Bearing of a Line.

Editor, *Journal,*

In the September number of *The Journal of the Engineering Institute of Canada* are some remarks by Mr. G. Blanchard Dodge, M.E.I.C., with respect to the above, which would appear to imply that the method in use on the Topographical Surveys Branch of the Department of the Interior might be used possibly by the *engineer,* to better advantage than the method described by the writer in the July number of the *Journal.*

In the writer's opinion, however, based on the experience of many years both as a *surveyor* and as an *engineer* this, on examination, will be found to be not altogether the case.

Not that the writer would presume to criticize in any way the admirable set of tables issued by the Surveyor General's Office. On Dominion Land Surveys, and for Land Surveyors in general, these tables (which as Mr. Dodge points out are freely and kindly given to any member of the Engineering Institute who so desires) would be of the very greatest value and assistance.

They would not appear, however, to lend themselves readily to the ordinary work of an engineer, and, as distinctly stated at the outset, it was the *Engineer* the writer had chiefly in mind when preparing the table to which Mr. Dodge refers.

The reason why a method and tables, entirely applicable in the former, should not be also so in the latter case, would seem to lie in the somewhat fundamental difference of view point of the surveyor and the engineer with regard to the question.

The establishment of a true meridian, is, by the surveyor, looked on as a matter of course, a thing to be done in the ordinary routine of his profession. He, therefore, very naturally, provides himself with an instrument, a timepiece, and all the accessories suitable for the prosecution of such work. Thus provided, and with a set of tables such as supplied by the Surveyor General's office, the operation for him, becomes quite a simple, every day affair.

The engineer, on the other hand, (generally speaking of course) regards the obtaining of the true bearing of a line as being, perhaps desirable, but not usually *essential.* If a direct and easy way to accomplish it can be shown him, he is willing possibly to undertake the operation, but otherwise will likely content himself with some rough approximation, or by using as a starting point, simply a *magnetic* bearing. His mind is taken up largely with questions of location, or other matters, to him, much more important than the precise bearing of a line, and any suggestion of *sidereal* time or other astronomical term is likely to prove, only an irritation. He knows about them, knows that by giving the necessary time to it, he could become familiar with the subject, but, regarding the matter as being somewhat outside his proper sphere, does not usually *choose* to do so.

Again, with regard to equipment, most engineers, finding it more convenient for general purposes, prefer using an instrument giving an *erect* image, and such an instrument is not suitable for an observation of a star by *daylight* (owing to the loss of power due to the extra lenses). Many engineers, too, when it is a question only of measuring horizontal angles, and of producing long tangments, find they can better get results by using a transit without a vertical circle, and lacking this, it would be impossible to find the pole star at all, unless it were visible to the naked eye.

Generally speaking, therefore, for the engineer, an observation of the star by daylight is almost out of the question, and the principal part of the table as issued by the Surveyor General's office becomes of non-effect to him.

Further, while in this table, as Mr. Dodge observes, "Interpolation for the date is avoided by taking a mean position of the pole star over a certain period" this can *only* be done by using *sidereal* time. This necessitates the use of a sidereal watch, and few engineers would care to go to the expense of providing a sidereal watch for an operation that perhaps performed once, might not be again required for a year or more.

It is true, that using an ordinary watch, the table might still be employed, but this would complicate matters, and necessitate more interpolation than would be the case when using a table (giving direct mean time) of the form proposed by the writer.

Any engineer can recognize the north star when it is seen in connection with the well known constellation of the *Dipper,* and in every field party, there is always some one who has an ordinary watch that can be depended on to be within three or four minutes of the correct time. In employing the method which the writer has worked up, this is all the equipment necessary, for, as indicated in the original contribution in the July number, the field work consists in pointing at the north star any sort of a transit that happens to be available and measuring the horizontal angle between it and the line the true bearing of which is required. The time of the observation is noted and then, the exact position of the north star east or west of true north, at that particular moment is found by interpolation from the table.

In the most extreme case, the *interpolating* should not occupy more than a couple of minutes, and, as this consumes such a small part of the time of the operation as a whole, it is scarcely worth considering. Interpolating has no terrors for an engineer, for in his ordinary practice, he is constantly doing this in connection with tables of one kind or another.

In preparing the table, the time was taken between six and nine p.m. as between these hours, it is always possible, winter or summer, on a clean right to see the star, and it was not thought desirable to render the table

more bulky by extending it beyond this. The latitude taken is between 40 and 50 degrees, or ten degrees, as this is an easy number to use in interpolating, It was not thought advisable to carry it north of 50 degrees, for the reason that above that latitude, (without a *diagonal* eye piece which few engineers usually carry) it is difficult on account of its altitude, to see the north star directly. Any engineer who is so provided, however, can still use the table without introducing any material error, by interpolating for a few degrees above 50 degrees, using the same rate of change as given in the table between 40 and 50 degrees.

A table for *one* year only, would be of little use as it would almost surely be *out of date* when wanted. The period of six years was chosen by the writer simply for the reason that on a single folded sheet which can be conveniently inserted at the back of an ordinary field book, it was found possible to print, (with the necessary explanations) a six years table. From time to time, this could be renewed.

The writer trusts that too much of your space has not been occupied with the above explanation. As one, however, who has given a great deal of thought to the subject, he desired to bring out the point that Mr. Dodge was drawing attention to one thing, the *best* way of doing a thing in accordance with the practice of the *surveyor*, while the writer had in mind, a *suitable* way of doing the same thing under the restrictions imposed upon the *engineer* by the nature of his work.

Yours truly,

E. S. M. Lovelace, M.E.I.C.

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Editor, *Journal*,

I feel it is time that engineers take up the matter of having the profession recognized as other professions are recognized by the public and by law. I think it is the duty of the Engineering Institute of Canada to use every possible means in their power to have legislation enacted recognizing the engineering profession. When this is done, every engineer will feel that it is his duty to become a member of the Institute. Since the formation of your branch in St. John and after having attended the meeting in Halifax, I feel that the Institute has done more in the past year to obtain results than has been done in the previous ten years.

I will do all that lies in my power to assist you in having legislature put through in the Province of New Brunswick. I assure you of my hearty co-operation and feel that I will be able to interest some of the most able members of parliament in the cause of the Institute. My services in this regard are at your disposal at any time you may call upon me.

Yours very truly,

A New Brunswick Engineer

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Editor, *Journal*,

On page 96, Vol. 1, No. 2, of the *Journal*, I notice you say, "There is now continuous rail communication within 150 miles of Port Nelson." The steel is laid to the Kettle Rapids Bridge which is only ninety-two miles from the Port and during the summer trains run to the end of steel weekly (if possible).

Yours very truly,

Alexander D. Ferguson, A.M.E.I.C.

Saskatchewan Branch News.

After August and the "strenuous" professional meeting at Saskatoon had passed, the routine work of the branch was resumed on September 12th, when a very representative number of members gathered from Regina, Moose Jaw and Swift Current at the Assiniboia Club, Regina, to their monthly dinner, following which the regular branch meeting was held.

The evening was devoted to a discussion of the proposed "Act respecting the Engineering Profession". Clause after clause was thoroughly discussed and the original draft considerably curtailed and altered. Some of the sections took up the attention of the members for some considerable time, until midnight arrived, when the meeting was adjourned, when half of the draft had been discussed.

A special meeting has been called for September 19th, to continue the work. Copies of the proposed act had been sent to the Parent Institute and to all the branches, but until now no criticism or other communication has been received, except a telegram from the Ottawa Branch, suggesting some change in the Act, which suggestion was acted upon.

In view of the fact that it seemed to be the opinion of the members present at the professional meeting at Saskatoon to try and obtain legislation in the Western Provinces—at least—as soon as possible, it is essential that the various branches take action, so as to complete revision and discussion at an early date.

Concrete Bridge, near Craik, Sask.

* * *

A 64 ft. reinforced concrete span has been completed by O. W. Smith, M. E. I. C., over the Little Arm River, near Craik, Sask. under the supervision of F. Saynor A. M. E. I., resident engineer for the Provincial Highway Department. The design was made by E. G. W. Montgomery, A.M.E.I.C., acting as asst. chief engineer of the highway department, Regina. It involved the use of about 33,000 lbs. of steel for reinforcements and the pouring of about 278 cubic yards of concrete. The abutments are supported by a pile foundation (37 piles under each). It took about ten weeks to complete.

PERSONALS

J. R. Reid, A.M.E.I.C., has been moved as district superintendent of Highways to Swift Current, Sask.

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E. A. Markham, A.M.E.I.C., is in charge of construction on the enlargement of the provincial sanatorium at Ft. Qu'Appelle, Sask.

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Frank M. Preston, A.M.E.I.C., who has been assistant city engineer of Victoria for the past two years succeeds Mr. Rust as city engineer.

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F. A. Dallyn, A.M.E.I.C., who has been engineer of the Ontario Board of Health, has joined the Overseas Force to Siberia and will have charge of the water supply.

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Frank P. Jones, A.E.I.C., general manager of the Canada Cement Company has been made a member of the new Board of Directors of the Canadian Northern Railway.

* * *

E. L. Cousins, A.M.E.I.C., chief engineer and manager of the Toronto Harbor Commission, has accepted the appointment of deputy fuel controller for the Province of Ontario.

* * *

G. F. Layne, S.E.I.C., Lieutenant Royal Field Artillery, has recently been transferred to Egypt after recovering from severe wounds received at Menin Road in Flanders, and which kept him in the hospital for many months. Lieut. Layne has recently applied for transfer to higher grade.

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C. H. Rust, M.E.I.C., Past President, who left Toronto about six years ago to accept the position of city engineer of Victoria, has resigned his position there and has returned to Toronto, where he will be associated in an engineering advisory capacity with the Toronto Railway Company.

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Word has been received from the Front that Major A. E. Dubuc, M.E.I.C., D.S.O., who has been in command of a famous French-Canadian unit has been wounded for the third time. It is stated that his wounds are serious but not dangerous and it is hoped by his many friends in Montreal that he may speedily recover.

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Message from India

One of our corporate members, J. Darlington Whitmore, A.M.E.I.C., residing in India writes concerning the *Journal*, "Permit me to compliment you upon inaugurating such a welcome departure; I am confident it will tend to all that is good and hopeful," showing that it is not only in Canada that the Journal is being appreciated.

George Reakes, A.M.E.I.C., of St. Lambert, recently received a private cable stating that his son, Signaller J. H. Reakes who had been admitted to the General Hospital, Le Treport on September 3rd, suffering from gunshot wounds, had been transferred to Suffolk, England. Signaller Reakes was previously wounded in May 1917 by the explosion of a bomb in a captured German dugout He enlisted when eighteen years of age in the 73rd battalion under Lieut.-Col. Peers Davidson.

G. A. Mountain, M.E.I.C., chief engineer of the Railway Commission, representing the Government, officially declared the Canadian Northern tunnel through Mount Royal open for traffic on September 20th. On this occasion the first passenger train passed from the new station through the tunnel, inaugurating the new traffic service which will connect Montreal with Vancouver. It is expected that a daily service between Montreal and Toronto will be inaugurated this month.

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Valuation Chairman

Wm. McNab, M.E.I.C., valuation engineer, Grand Trunk Railway, has been appointed chairman of the valuation committee, a board of Grand Trunk officials formed in accordance with an act of the United States Congress, directing the Inter-State Commerce Commission to secure the valuation of all property owned or used by the common carriers. Arthur Crumpton, M.E.I.C., succeeds Mr. McNab as valuation engineer.

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Fuel Controller Given Wide Power

C. A. Magrath, M.E.I.C., has been appointed director of coal operations for Nova Scotia and New Brunswick as part of his powers as Fuel Controller. The order-in-Council making the appointment states that

1. The price to be paid for coal and coke produced in Nova Scotia and New Brunswick during the period mentioned shall be subject to the approval of the director of coal operations.

2. The director, with the approval of the Governor-in-Council, may take possession of any mine or mining plant within the Provinces aforesaid and may undertake and carry on the management, operation, and use of any such mine or mining plant; but such possession by the director under this regulation shall not affect any liability of the actual owner, agent or manager of the mine, or mining plant, as the case may be under any law or statute in that behalf.

3. The director may appoint such officers and agents as may be necessary to assist him.

4. The director, for the purpose of any inquiry or investigation made under the provisions of the regulation, is given the powers of a commissioner under the Inquiries Act.

Any corporation, company, or person guilty of an offence under the regulations is liable to a penalty not exceeding five thousand dollars, or to imprisonment for a term not exceeding three months, or to both fine and imprisonment.

Col. J. S. Dennis, C.M.G.

Past President Col. J. S. Dennis, has received recognition for his valuable services with the British-Canadian Recruiting Mission by having conferred upon him the order of Companion of St. Michael and St. George. That he should make an outstanding success of his work with the Recruiting Mission was an assured fact in the minds of those who knew him and this success is in keeping with the precedents he has established in connection with everything that he undertakes. During

COL. J. S. DENNIS, M.E.I.C.

the eighteen months which Col. Dennis has been engaged on this work he has kept in close touch and directed the operation of his department of the Canadian Pacific Railway where he has been for some time Chief of Colonization and Development, which is one of the most important executive positions in the company's entire system. Col. Dennis' fellow members in the profession will be glad to hear of this tribute to him on the part of the Imperial Government.

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Lieut.-Col. Colin W. P. Ramsey, C.M.G., M.E.I.C., Weds

On the afternoon of September 19th Lieut.-Col. Colin W. P. Ramsey, M.E.I.C., of Montreal who is a highly esteemed member of this Institute was married to Miss Dorothy Jackson, youngest daughter of Sir John Jackson, M.P., at St. Peters Church, Eaton Square, London, the occasion being a notable military and social event. Lieut.-Col. Colin Ramsey is a well known Montrealer being for many years in the engineering department of the Canadian Pacific Railway and for several years before the outbreak of the war was engineer of construction on Eastern Lines. When it was decided in 1915 to send over a Canadian Railway Construction Corps, he was appointed to command the corps, with rank as lieutenant-colonel. This work was so strongly backed by the Canadian Pacific, and so many of their engineers and employees volunteered for this service that it was familiarly known as the "C.P. Railway Overseas Corps."

Lt-Col. Ramsey organized the corps, which was mobilized here, and took personal charge of the work of selecting officers and men from all over Canada for this important work, many volunteering from the G.T.R. and C.N.R., as well as from other railways.

Shortly after organization the battalion went overseas, as the first Canadian Railway Construction Corps. They soon got into harness back of the front, and made a name for themselves as masters of the art of speedy railway construction and reconstruction, which was recognized as one of the most important factors in military operations.

So notable was the work done by his railway construction corps in the war service that shortly after their getting to work Lt.-Col. Ramsey was created C.M.G., in recognition of his services. He has lately been given an appointment in the railway service of the War Office.

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Brigadier-General G. Eric McCuaig. C.M.G., D.S.O. with Bar

Going overseas at the outbreak of the war with the rank of Major, G. Eric McCuaig, B.Sc., A.M.E.I.C., has had one of the most distinguished careers of any Canadian. He was in the hardest of the fighting from the start and due to conspicuous service, devotion to duty his rise has been rapid and recently he was gazetted Brigadier-General at the age of thirty-three. Several time he has been mentioned in despatches and he has

BRIG.-GEN. G. ERIC McCUAIG, C.M.G., D.S.O. with Bar, A.M.E.I.C.

been twice wounded. It is men of his type that are adding distinction to the engineering profession and engineers are proud of the latest success of the youngest General in the Canadian division.

Howard Kelley, M.E.I.C., president of the Grand Trunk Railway System was re-elected to the position at the recent annual meeting of the Board of Directors.

HOWARD G. KELLEY, M.E.I.C.
Recently re-elected President of the Grand Trunk Railway System.

* * *

Engineer Cabinet Minister.

Hon. Jean Leon Cote, A.M.E.I.C., member of Alberta Legislature for Grouard has just been appointed by Premier Stewart, provincial secretary for the Province of Alberta. The information that a member of the profession has been appointed as a member of the Cabinet of the Alberta Government will be read with pleasure by his fellow members of the Institute. Since the inception of the Edmonton Branch Mr. Cote has been a member of the Branch executive and has always taken a keen interest and has been an active worker in the welfare of the Branch. As provincial secretary, he brings to the service of the Government a wide experience and an excellent training and those who know him best predict that he will make a splendid success as an administrator.

In the legislature Mr. Cote has always been one of the hard working members, punctual in attendance at committees and in the house, and has taken an active part in shaping the legislation of the province. Since 1913 he has been chairman of the railway committee in the legislature. Mr. Cote is considered the best informed man in the province upon the mines and minerals and all the natural resources of the country.

Mr. Cote was born at Les Eboulements, Quebec, on May 6, 1867. He was educated at the commercial academy at Montmagny, Quebec, and later at Ottawa University, from which he graduated in 1890. Mr. Cote then entered the engineering profession. From 1894 to 1897 he was employed by the Dominion government on the Alaskan boundary survey between Canada and the United States. He moved to Dawson, Yukon territory, in 1898, and there followed the business of legal surveyor and mining engineer until 1903. In 1907 he moved to Alberta and established himself as Dominion land surveyor and engineer. At present he is interested in coal mining, being president and treasurer of the Jasper Park Collieries, Ltd., and is head of the firms of Cote, Smith and Cote, Tremblay & Pearson.

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Hamilton Branch

The Hamilton Branch of the Engineering Institute of Canada was opened with a very successful and well attended meeting in the Royal Connaught hotel on Saturday evening, September 21. The branch was fortunate in having as the lecturer of the evening the noted engineer and inventor, P. M. Lincoln, past president of the American Institute of Electrical Engineers, and engineer of the Westinghouse Electric and Manufacturing company, Pittsburg. His subject was "The Development of Electric Power Transmission," and his lecture included a short historical review, a comprehensive summary of the many difficult problems encountered and solved by transmission engineers, and a forecast of probable developments in the near future.

The phenomenally rapid growth of electric power transmission in the short space of 25 years, as outlined by Mr. Lincoln, was one of the romances of engineering. In 1891 power was transmitted one mile at Pittsburg. In 1892 a distance of three miles was covered in Colorado. The next year the record for commercial transmission passed to California, with a distance of ten miles. Then, in 1895, thirty miles was reached in the same state, and fifty-five miles in 1897 in Colorado. The growth was rapid and continuous, reaching one hundred and five miles in Mexico in 1903, and culminating in a two hundred and forty mile line built in California in 1912, which used the record voltage of 150,000 volts.

H. R. SAFFORD, Member of Council, E.I.C.
Who resigned his position of Chief Engineer of the Grand Trunk Railway to become engineering advisor to the Central Western Region, United States Railway Administration.

ENGINEERING INDEX

In this department will be published from month to month the titles of current engineering papers with the authors and source and a brief extract of the more important, which is designed to give the members of The Institute a survey of all important articles relating to the engineering profession and to every branch of the profession.

AERONAUTICS

Aerostatics. Military Aerostatics, H. K. Black. Aerial Age, vol. 7, nos. 22 and 23, Aug. 12 and 19, 1918, p. 1064, 1 fig., pp. 1118-1119, 1 fig. (Aug. 12). Features of the Cacquot observation balloon; (Aug. 19). Action of automatic valve. (Continuation of a serial.)

Altitudes. The Flight of an Aeroplane at Different Altitudes, L. de Bazillac. Translated from original French by B. Bruce Walker. Flight, vol. 10, nos. 28 and 29, July 11 and July 18, 1918, pp. 779-781, 4 figs., and pp. 811-813, 3 figs. (July 11). Equations involved in the study of two ways of flying the aeroplane under the thrust of contact: 1, at constant speed and increasing altitude, the engine running normally all the time; 2, keeping altitude constant by reducing speed of engine in proportion in which the oil and petrol are consumed (July 18). Curves and formulæ; resistances per unit. Weight in terms of angle of attack. (Continuation of serial.)

Engine Pistons. Report on Aluminum Pistons from 230 HP. Benz Engines. Aeronautics, vol. 15, no. 247, July 10, 1918, pp. 46-48, 4 figs. Details of design and result of a metallurgical analysis of the composition of the alloy carried out of R.A.E. Engine was taken from the Aviatik biplane G. 130, captured Feb. 12, 1918. Issued by Technical Dept., Aircraft Production, Ministry of Munitions. Accounts also published in Flight, vol. 10, no. 27, July 4, 1918, 4 figs. Automotive Industries, vol. 39, no. 9, Aug. 29, 1918, p. 361, 2 figs.; Aviation, vol. 5, no. 2, Aug. 15, 1918, p. 93, 1 fig.; Engineering, vol. 106, no. 2740, July 5, 1918, p. 18, 4 figs.

Engine Temperature Control. Making the Aviation Engine fit for any Altitude. Sci. Am., vol. 119, no. 6, Aug. 10, 1918, p. 109. Automatic temperature control used in Sturtevant engine.

Engines. The 180 hp. Mercedes Aero-Engine. Aviation, vol. 5, no. 2, Aug. 15, 1918, pp. 98-101, 10 figs. Report on design of engine issued by the Technical Department. Aircraft Production. British Ministry of Munitions.

The Design of Aeroplane Engines, John Wallace. Aeronautics, vol. 15, nos. 247 and 248, July 10 and July 17, 1918, pp. 44-46, 5 figs., and pp. 59-61, 3 figs. (July 10), Air and water cooling of the cylinders; indicator diagram; compression ratio; mean effective pressure; (July 17). power; construction of theoretical indicator diagram; comparison of results. Continuation of serial.)

Individual Types. Report on the Friedrichshaffen Bomber. Flight, vol. 10, nos. 27, 28 and 29, July 4, 11 and 18, 1918, pp. 737-741, 770-773, 41 figs., and pp. 793-796, 15 figs. F.D.H. G. 3 brought down by Anti-aircraft fire at Ishergues on Feb. 16. Construction of wings, struts, ailerons, fin and fixed tailplanes; elevators, rubbers, bracing, fuselage, engines, radiators, oil pump, petrol tanks, pipings, and propeller. Issued by Tech. Dept., Aircraft Production, Ministry of Munitions. (July 18). Controls; landing gear; instruments; bombs and bomb gear; fabric. (Concluded.)

Some War-Time French Airplanes and Hydroplanes. Automotive Eng., vol. 3, no. 7, Aug. 1918, pp. 304-309, 5 figs. Details of the machine design and construction, also their machine-gun and other equipment. Type of motor mostly used. Some well-known fighting planes of widely varying types. (Second of series.)

The L.V.G. Biplane Type C.V. (Translation from L'Aérophile). Aerial Age, pp. 1122-1123. Comparative specifications of L.V.G. biplanes C.II, C.IV, C.V, and Rumpler C.IV.

The Roland Single-Seater Chaser, D. II. Flight, vol. 10, no. 28, July 11, 1918, pp. 765-767, 8 figs. Dimensions, construction of fusalage, form of planes, shape of tail, and armament. (Translated from L'Aérophile.) Also published in Automotive Industries, vol. 39, no. 7, Aug. 15, 1918, pp. 267-268, 2 figs. Mechanical details of fast machine of light construction; fuselage built of plywood covered with fabric.

The S.E. 5A Single Seater Fighter. Automotive Industries, vol. 39, no. 8, Aug. 22, 1918, pp. 315-317, 2 figs. Mechanical details of British machine adopted by U.S. Army authorities; weighs 1554 lb. without load and is equipped with 200 hp. Hispano engine.

Instruments. Navigating Instruments of our Aerial Pilots. Sci. Am., vol. 119, no. 7, Aug. 17, 1918, pp. 141-142. Tachometer, air speed indicator, altimeter, airplane compass, airplane clocks, pressure gages, radiator thermometer, banking indicator and Aldis sight.

Italian Air Service. Plans and Accomplishments of the Italian Air Service. Automotive Industries, vol. 39, no. 7, Aug. 15, 1918, pp. 272-276, 13 figs. Types of machines that have been developed.

Metal Fittings. Strut Sockets and Other Sheet-Metal Airplane Fittings, Fred H. Colvin. Am. Mach., vol. 49, no. 6, Aug. 8, 1918, pp. 253-256, 15 figs. Illustrated description of making of built-up combinations of sheet-metal stampings and of forgings and stampings.

Model Aeroplanes. Model Aeroplane Building as a Step to Aeronautical Engineering. Aerial Age, vol. 7, no. 22, Aug. 12, 1918, 1 fig. Drawing giving size and dimensions. (To be continued).

Model Aeroplanes, F. J. Camm. Aeronautics, vol. 15, no. 248, July 17, 1918, p. 68. Study of problem of maintaining coincidence of centers of pressure and gravity in aeroplane flying. (To be continued.)

Mufflers. Exhaust Headers and Mufflers for Airplane Engines, Archibald Black. Gas Eng., vol. 20, no. 9, Sept., 1918, pp. 429-436, 14 figs. Types that have been used and are being used; figures from tests of loss due to muffler; list of references to other literature. Also published in Automotive Industries, vol. 39, no. 4, July 25, 1918, pp. 145-157, 15 figs. Paper presented before S.A.E.

Propellers. Notes on Airscrew Analysis, M. A. S. Riach. Aeronautics, vol. 15, no. 247, July 10, 1918, pp. 41-42, 2 figs. Modifications introduced into the original theory, outlined in The Screw Propeller in Air, Proc. Aero. Soc., Mar. 21, 1917, in order to take account, in a quantitative manner, of the conception of a rotation set up in the fluid both before and behind the actuator disc. (Continuation of serial.)

Predicting Strength and Efficiency of Airplane Propellers, F. W. Caldwell. Automotive Industries, vol. 39, no. 4, July 25, 1918, pp. 152-155. Formulæ and curves; Conventional design compared to adjustable-pitch propeller; efficiency under climbing conditions; comparison of climbing rates; engine with constant torque. (Concluded.) Also published in Aerial Age, vol. 7, no. 21, Aug. 5, 1918, pp. 1011-1018, 14 figs.

The Efficiency of an Airscrew, M. A. S. Riach. Aeronautics, vol. 15, no. 247, July 10, 1918, pp. 38-39. Examination of the quantities in the formula for the efficiency of any blade element, $N^1x = \tan A/\tan (A^1 + v^1)$ derived in "The Screw Propeller in Air," Proc. Aero. Soc., Mar. 21, 1907.

Wooden Wings for the Modern Mercury, Motor Boating, vol. 22, no. 2, Aug. 1918, pp. 22-23. Various processes employed by the French in the manufacture of propellers for their airplanes.

Royal Aircraft Factory. Products of the Royal Aircraft Factory, Automotive Industries, vol. 39, no. 6, Aug. 8, 1918, pp. 236-238, 12 figs. Models of planes developed by British Government. Further development work left to private concerns.

Standards. International Aircraft Standards. Aeronautics, vol. 15, no. 248, July 17, 1918, pp. 66-67. Specifications for aeroplane spar varnish; specifications for mercerized cotton aeroplane fabric. (Continued.)

Steel Tubes. Steel Tubes Manipulation and Tubular Structures for Aircraft, W. W. Hackett and A. G. Hackett. Automotive Eng., vol. 3, no. 7, Aug. 1918, pp. 315-318. Front forks for cycles; tapered tubes; tubular liners or re-inforcements; tube manipulation; tubular joints in aircraft construction; soft-soldered joints; tests on soldered joints; brazing; silver-soldering; welding. Second of series.)

Wing Fabrics. Cotton Airplane Fabric, S. Wakefield. Textile World Jl., vol. 54, no. 7, Aug. 17, 1918, pp. 37-39, 1 fig. Construction of yarn and cloth for standard specifications.

Wing Ribs. A New Method for the Testing of Airplane Wing Ribs, I. H. Cowdrey. Automotive Industries, vol. 39, no. 4, July 25, 1918, pp. 140-144, 5 figs. Shows how load application and distribution are controlled by a series of rubber bands, and describes apparatus employed.

AIR MACHINERY

Lubrication. Lubrication of Air Compressor Cylinders, W. H. Callan. Power, vol. 48, no. 7, Aug. 13, 1918, pp. 229-230. Résumé of experience showing that a light mineral oil is the lubricant to use.

Soot Blowers. Soot Blowers for Vertical and Hollow Stay-Bolt Boilers. Power, vol. 48, no. 7, Aug. 13, 1918, pp. 222-228, 21 figs. Details of various systems employed; protection for blower elements in high-temperature zones; blowers for hollow-staybolt boilers; continuous ash removal.

Tire Pumps. Official Test of Tire Pumps. Automotive Industries, vol. 39, no. 6, Aug. 8, 1918, p. 243, 1 fig. Curve showing r.p.m. of pump against seconds required to inflate tire, drawn from results obtained at laboratory of Automobile Club of America, New York, with the Cassco power tire pump.

Turbo Compressors. Turbo Air Compressor at the Holbrook Colliery. Engineer, vol. 126, no. 3267, Aug. 9, 1918, pp. 113-115, 7 figs. A 750-hp., 2 stage, reciprocating air compressor driven through helical gearing by a mized-pressure turbine. Description of unit and its auxiliaries.

Ventilating Fan. New Ventilating Fan at Hardwick Collieries. Iron & Coal Trades Rev., vol. 97, no. 2630, July 26, 1918, p. 91, 1 fig. A 15-ft. fan replaced by smaller one of the multi-blade type.

BRICK AND CLAY

Canadian Clay. Report of the Clay Resources of Southern Saskatchewan, N.B. Davis, Can. Department of Mines, no. 468, 1918, 93 pp., 21 figs. Report based on field work and laboratory tests, containing information regarding geological position, locality, and availability of each deposit, and behavior of samples tested in laboratories.

Clay Burning. Burning Clay Wares, Ellis Lovejoy. Clay-Worker, vol. 70, no. 2 Aug. 1918, pp. 128-130. Machine handling and setting; open-top continuous kilns. (Continuation of serial.)

Fire Brick—the Age of Clay Products. Brick & Clay Rec., vol. 53, no. 5, Aug. 27, 1918, pp. 369-371. How two plants in Pennsylvania are turning out their product.

BRIDGES

Concrete Bridges. Canadian Pacific Railway Viaducts at Toronto. Can. Engr., vol. 35, no. 6, Aug. 8, 1918, pp. 123-124. How it was possible to build two reinforced-concrete bridges 386 ft. long and 90 ft. high, having spans of 35 ft.

Concrete Highway Bridge Design. Surveyor, vol. 54, no. 138, July 5, 1918, p. 8. Ontario Highway Department's specifications.

Rebuilding the C. B. & Q. R. R. Bridge Over the Platte River, Near Grand Island, Neb. Ry. Rev., vol. 63, no. 4, July 27, 1918. pp. 117-120, 10 figs. Reinforced-concrete slabs on concrete piers with reinforced-concrete pile foundation.

STEEL BRIDGES. Bridge Across the River Vistula at Warsaw. Engineer, vol. 126, no. 3266, July 26, 1918, pp. 80-81, 5 figs. Description of 504 meter bridge completed at outbreak of war.
Four Span Steel Bridge Over the Nicolet River. Contract Rec., vol. 32, no. 27, July 3, 1918, pp. 519-520. Dimensions and brief account of erection.
The Economics of Steel Arch Bridges, F. K. Thomson, C. E. Fowler, W. B. Parr and H. P. Van Cleve. Proc. Am. Soc. Civ. Engrs., vol. 44, no. 6, Aug. 1918, pp. 843-870, 9 figs. Study and classification of 100 structures, discussion of J. A. L. Waddell's paper. (Concluded.)
The Hell Gate Arch Bridge and Approaches of the New York Connecting Railroad Over the East River in New York City, C. E. Chase and O. H. Ammann. Proc. Am. Soc. Civ. Engrs., vol. 44, no. 6, Aug. 1918, pp. 759-766. Discussion of O. H. Ammann's paper.

STRESSES. Why Do Some Bridges Stand Up? E. H. Darling. Contract Rec., vol. 32, no. 34, Aug. 21, 1918, pp. 655-656, 2 figs. Table of estimated stresses under various conditions.

TRUSS SPANS AND TOWERS. New Bridge on the B. & L. E. a Notable Structure. Ry. Age, vol. 65, no. 8, Aug. 23, 1918, pp. 345-351, 16 figs. Continouus trusses and unique construction methods noted.
Oregon-Washington Railroad and Navigation Company's Portland Bridge. Ry. Gaz., vol. 29, no. 2, July 12, 1918, pp. 46-50, 3 figs. Structure and substructure details of the three riveted truss spans and of the two towers between which the central span is lifted vertically.

WILSON BRIDGE. Wilson Bridge, Over the Rhone, at Lyon (Le pont Wilson, sur le Rhone, à Lyon), A. Dumas. Génie Civil, vol. 73, no. 2, July 13, 1918, pp. 21-28, 15 figs. Details of construction, sections and dimensions.

BUILDING AND CONSTRUCTION

COALING STATION. An Example of Modern Coaling Station Construction. Ry. Gaz., vol. 29, no. 5, Aug. 2, 1918, pp. 127-128, 4 figs. Ground plan showing track arrangement and elevation of towers of new reinforced-concrete structure at Manchester, N.Y.

CONDENSATION UNDER SURFACE. See Roof Construction below.

COORDINATION. Coordination Saves Six Weeks' Construction Time on Big Building. Eng. News-Rec., vol. 81, no. 7, Aug. 15, 1918, pp. 300-304, 5 figs. Duplicate equipment throughtout eliminates plant delays; manual operations proceed on time-table schedule, promoting esprit de corps.

GRAIN WAREHOUSE. New Reinforced-Concrete Grain Warehouse in Genoa (Nuovo magazzino in cemento armato per grani nel porto di Genova). Ingegneria Italiana, vol. 2, no. 30, July 11, 1918, pp. 17-23, 11 figs. General plans and dimensions.

MILL BUILDINGS. A Very Modern Manufacturing Plant, W. H. Roberts. Wood-Worker, vol. 37, no. 6, Aug. 1918, pp. 32-33, 6 figs. Notes on the fireproof construction, equipment methods, safety devices, ventilation, lighting, and sprinkler system of Weiss Mfg. Co., Monroe, Mich., manufacturers of sectional book-cases, office furniture, etc.
Is Wood a Suitable Material for the Construction of Mill Buildings? W. Kynoch and R. J. Blair. Contract Rec., vol. 32, no. 32, Aug. 7, 1918, pp. 622-623, 2 figs. Examination of facts from a technical standpoint.

ROOF CONSTRUCTION. The Relative Effectiveness of Various Types of Roof Construction in Preventing Condensation on the Under Surface, W. S. Brown. Building News, vol. 115, no. 3317, July 31, 1918, pp. 80-81, 1 fig. Graphs obtained mainly from experiments made in testing laboratory of F. P. Sheldon and Son, Providence, R.I. Paper before Nat. Assn. Cotton Mfrs.

SHIPYARD. Concrete Shipyard at Wilmington, N.C., A. G. Monks. Int. Mar. Eng., vol. 23, no. 8, Aug. 1918, pp. 452-454. Description of plant erected by Liberty Shipbuilding Co., Boston, Mass., for building concrete ships.

STACKS. Boiler House as Stack Foundation, L. C. Huff. Power, vol. 48, no. 5, July 30, 1918, pp. 150-152, 5 figs. Four-story concrete building used as foundation for 240 ft. steel stack; supports and bracing to withstand wind pressure.

WAREHOUSE. Army Depot at Chicago is Large Concrete Warehouse, A. Epstein. Eng. News-Rec., vol. 81, no. 6, Aug. 8, 1918, pp. 269-270, 1 fig. Floor area 29 acres in 6-story building; tracks on first floor; tunnels for trucking and utilities.

CEMENT AND CONCRETE

BUILDINGS. Economy in the Design of Concrete Buildings, C. W. Mayers. Contract Rec., vol. 32, no. 34, Aug. 21, 1918, pp. 659-662. Remarks and suggestions. Paper before Am. Concrete Inst.

CEMENT GUN. Varied Applications of the Cement Gun. Eng. & Cement World, vol. 13, no. 3, Aug. 1, 1918, p. 40. Recent uses and composition of mixture applied by cement gun.

COLUMNS. Economy in the Design of Columns for Concrete Buildings, Clayton W. Mayers. Contract Rec., vol. 32, no. 36, Sept. 4, 1918, pp. 712-716, 6 figs. Aberthaw Construction Co. Before Am. Concrete Inst.
Temperature Tests on Concrete Columns, W. A. Hull. Contract Rec., vol. 32, no. 31, July 31, 1918, pp. 605-607. Résumé of tests on gravel and limestone concrete columns carried out in the U. S. Bureau of Standands. Abstract of paper before Am. Concrete Inst.

DAMS. Lukewarm Concrete Enough Precaution for Zero Weather Dam Work. Eng. News-Rec., vol. 81, no. 6, Aug. 8, 1918, pp. 260-262, 3 figs. Perfect bond and sound concrete secured by placing 50-deg. mixture on frozen surfaces; concreting kept up in heavy frosts.

DETERIORATION. Action of Sea Water on Concrete in Structures Exposed to Tides (Action de l'eau de mer sur les ouvrages en béton exposés aux marées), E. R. Matthews. Mémoires et Comptes Rendus des Traveaux d la Société des Ingénieurs Civils de France, year 71, nos. 1-3, Jan.-Mar. 1918, pp. 40-42. Results of experiments made at Hull, England, on 6-in. cubes. Abstract of paper before Soc. of Civ. Engrs., France.
Concrete in Alkali Soil at Saskatoon, H. McI. Weir. Jl. Eng. Inst. of Canada, vol. 1, no. 4, Aug. 1918, pp. 153-154. Physical condition and appearance of a number of cases in alkali ground and comparison of these with conditions found in ground free from alkali.
Deterioration of Concrete, B. Stuart McKenzie. Jl. Eng. Inst. of Canada, vol. 1, no. 4, Aug. 1918, pp. 150-152. Examples of deterioration under various conditions and results of experiments conducted by City Analyst of Winnipeg.

FOREIGN CONCRETE REGULATIONS. English and Canadian Concrete Regulations. W. W. Pearse. Can. Engr., vol. 35, no. 7, Aug. 15, 1918, pp. 143-147. Comparison between Toronto's by-law regulating reinforced-concrete construction and new by-law of London County Council which adopts 180 lb. per sq. in. shearing stress and favors hooking the ends of reinforcing in beams.

MORTARS. Ancient and Modern Mortar, W. J. Dibdin. Concrete Age, vol. 28, no. 5, Aug. 1918, p. 19. Abstract of paper before Faraday Soc. of London.
Proportioning the Materials of Mortars and Concretes by Surface Areas of Aggregates, L. N. Edwards. Contract Rec., vol. 32, No. 31, July, 1918, pp. 599-604, 12 figs. Methods, materials used, results obtained and phenomena observed in a series of experimental tests undertaken to develop the practical application of this method. Abstract of paper before joint meeting of Am. Concrete Inst. and Am. Soc. for Testing Materials.

MIXING. Effect of Time of Mixing on the Strength of Concrete, D. A. Abrams. Can. Engr., vol. 35, no. 6, Aug. 8, 1918, pp. 132-134, 5 figs. Comparison of hand and machine mixing; effect of rate of rotation of mixer drum; effect of age on strength; curves showing temperature of mixing water against compressive strength; yield and density of concrete. (Concluded.)

REINFORCED CONCRETE. Discussion on Final Report of the Special Committee on Concrete and Reinforced Concrete, C. S. Bissell, Proc. Am. Soc. Civ. Engrs., vol. 44, no. 6, Aug. 1918, pp. 897-903. Method for designing reinforced beams and slabs from equations given in report. (Concluded.)

ROOFS. Concrete Roof Specifications. Contract Rec., vol. 32, no. 36, Sept. 4, 1918. p. 716. Recommendations of Sandusky Cement Co.

STRENGTH OF CONCRETE. Some Tests on the Effect of Age and Condition of Storage on the Compressive Strength of Concrete, H. F. Gonnerman. Can. Engr., vol. 35, no. 6, Aug. 8, 1918, pp. 135-137, 4 figs. Results of tests made at the Univ. of Ill. Paper before Am. Concrete Inst.

SWIMMING POOLS. How to Build Reinforced Swimming Pools. Concrete Age, vol. 28, no. 5, Aug. 1918, pp. 10-12, 3 figs. Suggestions for designing.

TIES. Concrete on Railways. Ry. Gaz., vol. 29, no. 3, July 19, 1918, pp. 72-74, 7 figs. Shapes and sizes of blocks used as ties for rails.

TRESTLES. Reinforced Concrete Trestles at North Toronto. Ry. Age, vol. 65, no. 7, Aug. 16, 1918, pp. 289-291, 7 figs. Unique details developed in viaducts designed as a substitute for steel construction.

CHEMICAL TECHNOLOGY

AMMONIA. Notes on the Catalytic and Thermal Synthesis of Ammonia, E. B. Maxted. Jl. Soc. Chem. Industry vol. 37, no. 14, July 31, 1918, pp. 232T-235T, 3 figs. Discussion of some points in the Haber synthesis and of methods employed and results obtained in connection with measurement of ammonia equilibrium at high temperatures.
The "Direct" Process of Sulphate Marking in Gas-Works, W. S. Curphey. Gas Jl., vol. 143, no. 2879, July 16, 1918, pp. 111-113. Experiments on rotation system ; effect of seasonal changes on ammonia ; discussion of results of investigations carried out at various works. From annual report of chief alkali inspector. (Continuation of serial.)

ANALYSIS, STEEL. Combustion Train for Carbon Determination, J. B. Stetser and R. H. Norton. Iron Age, vol. 102, no. 8, Aug. 22, 1918, pp. 443-335, 1 fig. Apparatus giving results in 6 min. and meeting color-test inaccuracies arising from varying heat treating of samples.
The Determination of Cobalt and Nickel in Cobalt Steel. W. R. Schoeller and A. R. Powell. Iron & Steel Inst. of Canada, vol. 1, no. 7, Aug. 1918, pp. 304-306. Application of process based on precipitation of hexammine cobaltons and hexammine nickelous iodides by means of potassium iodide in strongly ammoniacal solution, the precipitation of the trivalent metals by the ammonia being prevented by addition of tartaric acid. Paper before British Iron & Steel Inst. Published also in Blast Furnace & Steel Plant, vol. 6, no. 9, Sept. 1918, pp. 359-360; Proc. British Iron & Steel Inst., May 2-3, 1918, Paper no. 22, 5 pp.

ANALYSIS (VARIA). A Method for the Separation and Determination of Barium Associated with Strontium, F. A. Gooch and M. A. Soderman. Am. Jl. of Sci., vol. 46, no. 273, Sept. 1918, pp. 538-540. Results of attempt to adapt process used for separating barium from calcium and magnesium, which consists in throwing the barium out of solution by the addition of a 4; 1 mixture of concentrated hydrochloric acid and ether.
A new Method of Estimating Zinc in Zinc Dust, L. A. Wilson Eng. & Min Jl., vol. 106, no. 8, Aug. 24, 1918, pp. 334-336, 1 fig. Abstract from paper before Am. Soc. for Testing Materials.

CHARCOAL. Charcoal and Allied Industries (La destilacion de la madera). Boletin de la Sociedad de Fomento Fabril, year 35, no. 4, Apr. 1918, pp. 244-249. Processes used with different woods; obtainable by products and their temperatures of distillation. (To be continued.)

COAL-TAR PRODUCTS. Constituents of Coal Tar, P. E. Spielmann. Gas Jl., vol. 143, no. 2879, July 16, 1918, p. 114. Enumeration of multiple six-ring and of five-member ring hydrocarbons. (Continuation of serial.)
Notes on the Commercial Fractional Separation of Benzene, Toluene, and Xylenes, T. H. Butler. Jl. Soc. Chem. Industry, vol. 37, no. 14, July 31, 1918, pp. 220T-222T, 5 figs. Factors making efficiency in plants of coal-tar hydrocarbons.
The Recovery of Light Oils and Refining of Toluol. Engineering, vol. 106, no. 2743, July 26, 1918, pp. 83. Sources of light oils, coal-gas, water-gas and oil-gas; outline of processes; scrubbers, heat exchangers, super-heater and stripping still wash-oil cooler, condenser, separator, crude rectifying stills, agitator and rectifying stills.

Dyestuffs. Dyestuffs, I. J. Matos. Jl. Franklin Inst., vol. 186, no. 2, Aug. 1918, pp. 187-209, 8 figs. History of development of dye industry; chemistry of industry; diagrams illustrating manufacture of certain dyestuffs.

Filter. A New Form of Ultra-Filter. Jl. Am. Chem. Soc., vol. 40, no. 8, Aug. 1918, pp. 1226-1230, 2 figs. Laboratory arrangement consisting essentially of dialyzer and pervaporator connected by a siphon.

Glass. Electrothermic Methods of Glass Manufacture (Métodos electrotérmicos para la fabricacion del vidrio). Boletin de la Sociedad de Fomento Fabril, year 35, no. 3, Mar. 1918, pp. 161-170, 10 figs. Four types of furnaces: Becker, Brown, Jablochkoff and Sauvageon.

Scientific Glassware, Morris W. Travers. Jl. Soc. Chem. Industry vol. 37, no. 14, July 31, 1918, pp. 235T-239T. Account of efforts to replace Jena glass in recently established factory at Walthamstow, England.

The Manufacture of Optical Glass, S. A. Hand. Am. Mach., vol. 49, no. 9, Aug. 29, 1918, pp. 367-372, 7 figs. History of demand for optical glass and attempts to produce it finally resulting in success at Jena. The solving of the problem in America and its production here.

Laboratory. Equipping a Shop Laboratory. Mach., vol. 24, no. 12, Aug. 1918, pp. 1087-1090. 5 figs. Arrangement of shop laboratory and brief explanation of methods used in analysis of iron and steel.

Nitrates. The Nitrogen Problem in Relation to the War, A. A. Noyes. Sci. Am. Supp., vol. 86, no. 2224, Aug. 17, 1918, pp. 98-99. Resources and methods for making meterials required for explosives. Paper before joint meeting of Wash. Acad. of Sciences and Chem. Soc. of Wash. From Jl. of Wash. Acad. of Sciences.

Oil Industry. A New British Oil Industry, E. H. Cunningham Craig, F. M. Perkin, A. G. V. Berry and A. E. Dunstan. Jl. Inst. Petroleum Technologists, vol. 4, no. 15, Arp. 1918, pp. 110-134. Processes to obtain oil by distillation from oil-shales, coal, cannel coals and torbanites, blackband ironstones, lignite and peat.

Make More Gasoline From Petroleum, and Toluol, Too, Louis Bond Cherry. Automotive Eng., vol. 3, no. 7, Aug. 1918, pp. 319-320. Further details of process described in Jan. 1918 issue.

The Burton Process of Refining Petroleum, Burton. Petroleum Rev., vol. 39, nos. 833 and 834, July 6 and 13, 1918, pp. 5-6 and 31. How it was invented and developed. From address before Am. Chem. Soc.

Oils, Vegetable. On Refining of Niitzu Crude Oil (in Japanese), M. M. Ozuta and Kenzo Sato. Jl. Soc. M. E., Tokyo, vol. 21, no. 53, July 1918.

Peat. Galeine and Houlbert Apparatus for the Distillation of Peat (Appareil, système Galeine et Houlbert, pour la distillation des tourbes). Génie Civil, vol. 73, no. 2, July 13, 1918, pp. 34-35, 2 figs. Scheme and operation.

The Nitrogen Distribution in Peat from Different Depths, C. S. Robinson and E. J. Miller. Jl. Am. Peat Soc., vol. 11, no. 3, July 1918, pp. 158-191, 8 figs. Experimental work: Study of variation in nitorgen partition in peat with depth or age and state of decomposition; comparison of its composition with that of pure proteins; alkaline permanganate method. Reprint of Mich. Agri. College, Tech. Bul. no. 35.

Periodic Table. A Modification of the Periodic Table, Ingo W. D. Hackh. Am. Jl of Sci., vol. 46, no. 273, Sept. 1918, pp. 481-501, 2 figs. Prediction that no new gas can be discovered from periodic curves obtained by plotting the atomic weights of the known elements by their relative position in the displacement series and by their polar numbers; account for formation of such groups as Fe-Co-Ni, Ra-Rh-Pd, Os-Ir-Pt, and the rare earths; tables showing the close relationship between polar number and isomorphism and the periodicity of the specific gravity; system of the radioactive elements.

Potash. The Estimation of Potash, B. Blount. Chem. News, vol. 117, no. 3052, July 19, 1918, pp. 242-244. Method for the estimation of potash in siliceous rocks, clays, etc., by treatment with hydrofluoric and sulphuric acids.

The Prospects of Founding a Potash Industry in this Country, K. M. Chance. Iron & Coal Trades Rev., vol. 97, no. 2630, July 26, 1918, pp. 86-87. Paper with discussion, before Soc. of Chem. Industry, Bristol, July 1918.

Rubber. The Object of the Vulcanization Process. India-Rubber Jnl., vol. 56, no. 2, July 13, 1918, p. 9. Description of changes brought about.

What the Rubber Chemists Are Doing. India Rubber World, vol. 58, no. 5, Aug. 1, 1918, pp. 654-655. Influence of sodium sulphate, formalin, soda, bisulphite of soda, sodium triosulphate, sodium acetate, and sulphurous acid on the inherent properties; determination of nitrogen; comparative physical tests.

Sulphite. Bisulphite Liquor and Its Constituents, J. Beveridge. Paper, vol. 22, no. 23, Aug. 14, 1918, pp. 11-14. Study of the waste problem and suggestions for the recovery of useful materials.

Sulphite Pulp Manufacture, R. E. Cooper. Paper, vol. 22, no. 25, Aug. 28, 1918, pp. 11-13. Chemistry of process and details of various operations.

Wool. Present Practice in Wool Carbonization, Textile World Jl., vol. 54, no. 6, Aug. 10, 1918, pp. 25-27. Comparison of methods in present practice.

CLAY

(See Brick and Clay)

COAL INDUSTRY

Briquetting. The Briquetting of Lignites, R. A. Ross. Jl. Eng. Inst. of Canada, vol. 1, no. 4, Aug. 1918, pp. 162-166. Feasibility of meeting fuel requirements in Saskatchewan and Manitoba by utilizing prepared lignites and sub-bituminous coals.

The Briquetting of Western Lignites, R. A. Ross. Contract Rec., vol. 32, no. 34, Aug. 21, 1918, pp. 651-654. Present state of the art of producing carbonized lignite briquets: equipment recommended; commercial conditions; procedure. From report to Advisory Council for Scientific and Industrial Research.

Carbonization. Aspects of Low Temperature Carbonization of Coal, E. C. Evans. Jl. Soc. Chem. Industry, vol. 37, no. 14, July 31, 1918, pp. 212T-219T. Historical notes; theory of coking process; main differences in oven design ofr high and low-temperature carbonization processes; cost of plant. Published also in Colliery Guardian, vol. 116, no. 3304, July 26, 1918, pp. 176-177; Iron & Coal Trades Rev., vol. 97, no. 2630, July 26, 1918, pp. 88-89. Paper before Soc. of Chem. Industry.

Low Temperature Carbonization of Coals, J. L. Stevens. Chem. Eng. Eng. & Min. Rev., vol. 10, no. 114, March 1918, pp. 167-170, 2 figs. Mashek process for carbonizing lignite up to 500 deg. cent.; chemistry of coal. (Continuation of serial.)

Coal Deposits. Coal Deposits in the Llapo District (Los yacumentos carboniferos del distrito de Llapo), A. P. Figuerola. Boletin del Guerpo de Ingenioros de Minos del Peru, no. 89, 24 pages, 1 map. Geography of the carboniferous district of Llapo; coal deposits; quality of the coal.

The Santo Tomas Cannel Coal, Webb Co., Tex. George H. Ashley. Department of the Interior, U. S. Geol. Survey, Bul. 691-1, July 25, 1918, pp. 251-270, 12 figs. General features of the region; physical and chemical properties of the coal beds; mines and mining.

Coking. An Innovation in the Coke Industry, John L. Gans. Coal Age, vol. 14, no. 6, Aug. 8, 1918, pp. 256-257. Entrance of beehive coke interests into the realm of by-product coke manufacture.

Some Characteristics of American Coals in By-Product Coking Practice, F. W. Sperr. Jl. Franklin Inst., vol. 186, no. 2, Aug. 1918, pp. 133-163, 20 figs Relations of the by-product coke industry to modern warfare; technical phase of the subject.

The By-Product Coke Oven; Its Products, W. H. Blauvelt. Blast Furnace & Steel Plant, vol. 6, no. 9, Sept. 1918, p. 392. Coke oven gas; recovery of benzol. Paper before Am. Inst. Min. Engrs.

Labor Situation. The Labor Situation, R. Dawson Hall. Coal Age, vol. 14, no. 8, Aug. 22, 1918, pp. 365-367. General review of labor question in coal mines.

Micro-Chemical Examination. Micro-Chemical Examination of Coal in Relation to its Utilization, J. Lomax. Gas World, vol. 69, no. 1772, July 6, 1918, pp. 18-19. Methods used; results and their significance; carbonization results.

Mining. Can Output Be Increased Scientifically? W. E. Joyce. Coal Age, vol. 14, no. 8, Aug. 22, 1918, pp. 356-357. Writer believes a little modern science would increase coal output.

Coal Mining in Carbonado, Washington, F. G. Jarrett. Coal Age, vol. 14, no. 7, Aug. 15, 1918, pp. 308-312, 7 figs. Description of operations in very rough country.

Methods of Operation, J. F. K. Brown. Coal Age, vol. 14, no. 7, Aug. 15, 1918, pp. 313-315. Conditions influencing methods of coal mining.

Scraper Mining of Thin Bed Anthracite, E. P. Humphrey. Coal Age vol. 14, no. 7, Aug. 15, 1918, pp. 316-318, 4 figs. Loading coal by means of a V-scraper driven by power.

Wasteful Methods in Mining, R. G. M. Bathgate. Sci. & Art of Min., vol. 28, no. 26, July 27, 1918. pp. 473-475. Conditions in Indian coalfields. From presidential address before Mining and Geological Inst. of India.

War Conditions. The Coal Problem Under War Conditions. H. H. Stoek, Coal Age, vol. 14, no. 9, Aug. 29, 1918, pp. 393-396. Discussion, with suggestions of present situation.

Washing. A New Method of Separating Slate from Coal, H. M. Chance. Jl. Engrs Club of Phila., vol. 35-8, no. 165, Aug. 1918, pp. 369-377 and (discussion) 377-378, 6 figs. Survey of apparatus in present use; new methods of effecting separation by means of agitated mixture of sand and water constituting a fluid mass of relatively high specific gravity, in which the coal floats and the slate sinks; application of this principle to other ore-dressing problems, Paper before Engrs.' Club.

Notes on Coal Washing, L. Crawford. Gas World, vol. 69, no. 1172 July 6, 1918, pp. 14-15. Principle of the separation by washing of two particles of equal diameter; table of variations in size or in density necessary to produce appreciable variations in rate of fall, calculated from Rittinger's empirical formula for the limiting velocities of fall of various particles.

The Rheolaveur, W. Galloway. Proc. South Wales Inst. of Engrs., vol. 34, no. 2, July 19, 1918, pp. 105-112, 7 figs. Description of appliance for washing small coal along a sloping trough in a stream of water. From Bul. de la Société de l'Industrie Minérale.

CONCRETE

(*See Cement and Concrete*)

CONVEYING

(*See Hoisting and Conveying*)

DESICCATION

(*See Drying*)

DOCKS

France. American-Built Docks in France Completed by Pacific Coast Engineers Robert K. Tomlin, Jr. Eng. News-Rec., vol. 81, no. 5, Aug. 1, 1918, pp. 208-216 22 figs. Illustrated account of building of 4100 ft. structure.

New Orleans. New Orleans Builds Inner Harbor and Navigation Canal. Eng. News-Rec., vol. 81, no. 7, Aug. 15, 1918, pp. 304-307, 3 figs. Provides ocean docks and industrial sites on fixed level waterway between Mississippi River and Lake Pontchartrain.

DRYING

Evaporators. Liquid Level Control. Paper Mill, vol. 41, no. 36, Sept. 7, 1918, pp. 22-23 and 46, 2 figs. Device for automatically maintaining liquid levels in evaporators, closed and open tanks, etc., also for draining condensate from heating, drying, cooking and evaporating apparatus.

Low Temperature. Marmier and Canonne Apparatus for drying of Concentrating Liquids at Low Temperatures (Appareil Marimier et Canonne pour la dessiccation ou la concentration des liquides à basse température). Génie Civil, vol. 73, no. 4, July 27, 1918, p. 72, 1 fig. Apparatus operates under reduced pressure down to 37 deg. and is designed for preparation of concentrated serums and organic liquids.

Warm-Air Circulation. Drying by Warm Air Circulation. Eng. Rev., vol. 32, no. 1, July 15, 1918, pp. 11-16, 3 figs. Description of system adopted by the Sturtevant Eng. Co.

ELECTRICAL ENGINEERING

A. C. Motors. Calculation of Performance of Induction Motors Working in Conjunction with Fly-wheels and Slip Regulators, Herbert Vickers. Elecn., vol. 81, no. 12, July 19, 1918, pp. 248-250. Mathematical treatment of both the continuous and the intermittent slip regulator, also automatic slip regulator and Ward Leonard system.

Control of Induction Motors, C. E. Clewell. Elec. Wld., vol. 72, no. 10, Sept. 7, 1918, pp. 438-441, 12 figs. Fundamental methods outlined and explained, resistance-type starter, auto-transformer method, the use of the choke-coil feature and of so-called preventive resistance; automatic compensator.

The Commercial Application of Synchronous Motors, M. J. McHenry Elec. News, vol. 27, no. 13, July 1, 1918, pp. 33-36, 2 figs. Attempt to point out principal characteristics which make synchronous motors applicable to certain classes of service, and discussion of industrial use of these motors in relation to central station and its customers.

A. C. Rectifier. An Interesting Alternating Current Rectifier for Charging Accumulators. Wireless World, vol. 6, no. 65, Aug., 1918, pp. 271-272, 1 fig. Device operating by means of a vibration tongue, which actuated by magnets in circuit with alternating supply, automatically connects line first to one pair of contacts, then the other, in synchronism with supply current.

Armature Heating. Armature Heating in Traction Motors, L. Adler. Elecn. vol. 81, no. 2099, Aug. 9, 1918, pp. 311-312, 5 figs. Abstract of an article in Electrotechnische Zeitschrift, no. 26, 1917.

Bells. Electricity in Mining, L. Foker, Sci. & Art of Min., vol. 28, no. 26, July 27, 1918, pp. 472-473, 1 fig. Construction operation and comparison of trembler and single-stroke bells; resistance of bell coils. (Continuation of serial.')

Condensers. Static Condensers, W. B. Taylor. Gen. Elec. Rev., vol. 21, no. 8, Aug., 1918, pp. 565-569, 8 figs. Effect in service of using static condensers on circuits of low power factor, and comparison of this service with that afforded by installing additional deeder copper.

Dynatron. The Dynatron, A. W. Hull. Wireless Age, vol. 5, no. 11, Aug., 1918, pp. 941-951, 12 figs. Formulæs and calculations for the dynatron, à vacuum tube claimed to possess negative electric resistance; applications of the dynatron to radio work. (Continued.)

Electrodeposition. Construction and Operation of Electrolytic Copper Refinery, J. E. McAllister. Eng. & Min. Jl., vol. 106, no. 8, Aug. 24, 1918, pp. 337-341, 1 fig. From first report of Canadian Munition Resources Commission.

Experiments with the Copper Cyanide Plating Baths, Frank C. Mathers. Metal Indus., vol. 16, no. 8, Aug., 1918, pp. 359-360. Paper before Am. Electro-Chem. Soc., May, 1918.

The Process of Depositing Silver on Glass and China, Howard Pearsall. Brass World, vol. 14, no. 6, June 1918, pp. 157-158. Fornulæ and directions.

Electromagnets. The Stroke of an Alternating-Current Electromagnet, A. Thomalen. Elecn., vol. 81, no. 2097, July 26, 1918, pp. 267-268, 6 figs. Abstract of an article in Electrotechnische Zeitschrift, no. 39. A mathematical treatment.

Frictional Electricity. Experiments on Tribo-Electricity, P. E. Shaw. Elecn., vol. 81, no. 10, July 5, 1918, p. 209. Experiments in frictional electricity with solid bodies rubbed together under different physical conditions, Abstract of paper in Proc. of the Royal Soc.

Furnaces. Electric Furnace for Melting Alloys, William H. Easton. Elec. Work, vol. 72, no. 7, Aug. 17, 1918, pp. 295-297, 3 figs. Control apparatus must be carefully selected to provide for heavy fluctuation of load; graphic records of power demand when melting nichrome and nickel steel in electric furnaces.

Temperature Uniformity in an Electric Furnace, J. B. Ferguson. Phys. Rev., vol. 12, no. 1, July 1918, pp. 81-94, 9 figs. Discussion of essential conditions for a proper control of temperature distrubution and of previous attempts made to secure these conditions; description of a type of horizontal furnace designed for investigation requiring a uniform temperature over the range 620-1190 deg.

Fuses. The Development of 2500-Volt Fuses, Robert Charles Cole. Elec. World, vol. 72, no. 10, Sept. 7, 1918, pp. 436-437. Experimental investigations leading to development of a fuse that is not destroyed by modern high-power short circuits.

Generators. A Direct-Current Generator for Constant Potential at Variable Speed, S. R. Bergman. Proc. Am. Inst. Elec. Engrs., vol. 37, no. 8, pp. 1011-1018, 6 figs. Theory, diagrams of connections, and performance curves of a machine claimed to be self-excited and capable of inherent and instantaneous regulation independent of speed, load and heating.

Generators Employed in Telephone Exchanges. Elec. Rec., vol. 24, no. 3, Sept. 1918, pp. 67-69, 12 figs. Construction and use in modern common-battery telephone exchanges.

High-Speed Turbo-Generators. Practucal Engr., vol. 58, no. 1641, Aug. 8, 1918, pp. 64-66, 7 figs. Survey of various methods of construction adopted by manufacturers in design of turbo alternators, and consideration of special characteristics of turbo direct-current machines.

Magnetic Pull in Electric Machines, E. Rosenberg. Proc. Am. Inst. Elec. Engrs., vol. 37, no. 9, Sept. 1918, pp. 1069-1113, 19 figs. Investigates whether in a given machine there is a "critical induction" which gives a higher unbalanced pull than any other induction and also the permissible deflection of machine parts in connection with the unbalanced pull, and influence of latter on critical speed.

One Way of Raising the Output of an Electric Generator (Sur un moyen de forcer la puissance d'un générateur électrique), Ch. Vallet. L'Industrie Electrique, year 27, no. 626, July 25, 1918, pp. 265-267. Numerical comparison of three systems of cooling an electric machine. (Concluded.)

Harmonics. Higher Harmonics in Polyphase Electric Systems, V. Karapetoff. Elecn., vol. 81, no. 12, July 19, 1918, pp. 250-251. Abstract of paper before Am. Assn. for Advancement of Science.

Inductive Interference. Inductive Effects of Alternating Current Railroads on Communication Circuits, H. S. Warren. Proc. Am. Inst. Elec. Engrs., vol. 37, no. 8, Aug. 1918, pp. 1019-1018. Discussion of inductive interference in general and in electrified railroads, including reference to work of Joint Committee on Inductive Interference in California: description of four important installations of railroad electrification and specific means adopted in each case for preventing interference, with degree of success which has been met with.

Lamps. Lamp Policy of the Fuel Administration. Elec World, vol. 72, no. 10, Sept. 7, 1918, pp. 457-460. Program of Federal authorities, by eliminating inefficient types of incandescent lamps, is expected to save more than 1,000,000 tons of coal a year.

Lightning Arresters. The Oxide Film Lightning Arrester, Crosby Field. Gen. Elec. Rev., vol. 21, no. 9, Sept. 1918, pp. 557, 6 figs. Description of construction and principle of apparatus.

The Oxide Film Lightning Arrester, Charles P. Steinmetz. Gen. Elec. Rev., vol. 21, no. 9, Sept. 1918, pp. 590-596, 8 figs. Short history of lightning protection of electric systems, ranging from the early communication circuits to the present night-tension, high-capacity transmission lines, employing small air gaps and the aluminum-cell lightning arrester; oscillograph records of tests on the oxide film arrester and discussion of its principle of operation.

Magnets. Non-Distributor and Multipolar Magnetos, F. I. Hoffman. Automotive Industries, vol. 39, no. 6, Aug. 8, 1918, pp. 222-223, 16 figs.

Discussion of practical possibilities of magnetos designed for use with separate distributors on the engine camshaft—multipolar magnetos delivering up to six sparks per revolution.

Motor Mounting. Notes on Electric Motor Mounting (Note sur le montage des moteurs électriques), A. Curchod. Revue Générale de l'Electricité, vol. 4, no. 5, Aug. 3, 1918, pp. 145-150, 20 figs. Diagram of connections for each of different types.

Power Factor. Effect of Power-Factor on Central-Station Operation, Will Brown. Elec. Rev., 73, no. 6, Aug. 10, 1918, pp. 199-202, 6 figs. Good voltage regulation and transmission efficiency can be obtained by installing synchronous motors.

Improving Power Factor by Static Condesner. Elec. Rev., vol. 73, no. 9, Aug. 31, 1918, pp. 317-230, 6 figs. Importance of high power-factor; application and sphere of the static condenser; with concrete examples and instances of its use.

Practical Limitations to Power Factor Correction, Ralph Kelly. Elec. Rev., vol. 73, no. 7, Aug. 17, 1918, pp. 243-244, 3 figs. Influence of location of corrective apparatus upon generator and conductor capacity and voltage regulation; proportioning of kilo-volt-amperes and kilowatts; sommation of individual power factors.

Radio Engineering. High Power Stations, C. H. Taylor. Wireless Age, vol. 5, no. 11, Aug., 1918, pp. 931-936, 2 figs. Features of the long-distance stations of the Am. Marconi Co. (Continued.)

Present State of Long Distance Radio-Telegraphy and the French Transoceanic Network. (L'état actuel de la radiotélégraphie à grande distance et le réseau transocéanique français). Leon Bouthillon. Génie Civil, vol. 73, no. 5, Aug. 3, 1918, pp. 84-98, 22 figs. Principles of operation of apparatus used and description of processes in large stations.

Progress in Radio Science. Wireless Age, vol. 5, no. 12, Sept. 1918, pp. 979-985, 10 figs. Apparatus devised for rectifying spark gap for high-tension alternating current; details of spark discharge for radio frequency oscillation circuits; x-ray tube wherein length of focus of cathode rays is varied at will of operator.

Progress of Wireless Telephony, E. E. Bucher. Wireless Age, vol. 5, no. 12, Sept. 1918, pp. 1014-1019, 7 figs. Diagram of Espenschild's duplex system and Englund's duplex simultaneous telephone and telegraph system.

Single-Impulse Radiography (Instantaneous); Its Limitations and Possibilities, R. Knox. Jl. Inst. Elec. Engrs., vol. 56, no. 275, June 1918, pp. 352-358. Development of method; comparison of exposures obtained from single-impulse set with mercury dip interrupter and from Siemens impulse outfit; types of apparatus; experiments to show differences obtained when exposing through screen on to plate and through glass on to plate and screen; standardization and technique.

Substations. The Standard Ourdoor Substation, J. T. Bronson. Gen. Elec. Rev., vol. 21, no. 9, Sept. 1918, pp. 640-651, 22 figs. Requirements of outdoor switching apparatus; outline of types and equipments of outdoor substations.

Telephones. Automatic Telephones at Australia House, London. Elecn., vol. 81, no. 2099, Aug. 9, 1918, pp. 317-318, 2 figs. Description of automatic exchange providing for 200 lines.

Construction and Operation of the Field Telephone and Buzzer, R. D. Greeman. Wireless Age, vol. 5, no. 12, Sept. 1918. pp. 1033-1035, 2 figs. Design of 4000 ft. signal set intended for junior military organizations.

European Telephone Practice, F. W. Scholz. Telephone Engr., vol. 20, nos. 2 and 3, Aug. and Sept., 1918, pp. 83-87, 9 figs., pp. 130-133, 6 figs. (Aug.) Artificial lines; location of defects in underground cables; Castelli apparatus for simultaneous telegpahing and telephoning; French measures to save materials. (Sept.) Chemical and physical theory of lead storage battery; some points on wireless telephony; new telephone selector used in France. (Translations from Revue Générale de l'Electricité and Annales des Téléphones.)

Telephone Exchange Transfers and Their Organization, G. C. Baldwin. Jl. Inst. Elec. Engrs., vol. 56, no. 275, June 1918, pp. 390-410, 24 figs. Operations for actual transfer and consideration of engineering processes accompanying work.

Transformers. Current Transformer Ratio and Phase Error by Test Ring Method, H. S. Baker. Proc. Am. Inst. Elec. Engrs., vol. 37, no. 9, Sept. 1918, pp. 1173-1183, 6 figs. Method of testing by connecting the primary and secondary of transformer under test respectively in series with the primary and secondary of a special current transformer in which number of turns in secondary coil is varied until primary and secondary ampere turns in special transformer are equal to each other.

Radiator Tank Transformer, H. O. Stephens and A. Paline. Gen. Elec. Rev., vol. 21, no. 8, Aug. 1918, pp. 556-559, 8 figs. Construction rules and details of the latest forms.

Transient Phenomena. Reactance and Short-Circuit Current, R. E. Doherty, Gen. Elec. Rev., vol. 21, no. 8, Aug. 1918, pp. 562-564, 7 figs. Non-Mathematical dissertation of quantitative effect of reactance on short-circuit currents.

Short-Circuit Windings in Direct-Current Solenoids, O. R Schurig. Gen. Elec. Rev., vol. 21, no. 8, Aug. 1918, pp. 560-562, 2 figs. Application to designs of the phenomenon consisting in the prolongation of time taken by flux to decay after removal of the magnetizing force when a short-circuited winding surrounds a magnetic core.

Transmission Lines. Aerial Cable Construction Kinks. Telephony, vol. 75, no. 6. Aug. 10, 1918, pp. 13-15. Methods and devices developed in construction of section between New York and Albany which facilitated rapid placing of cable.

Aerial Line Construction in France, H. G. A. Sansom. Transmitter, vol. 28, no. 3, July 18, 1918, pp. 19-24, 11 figs. Lecture before Victorian Postal Elec. Soc.

Detective and Protective Devices for Electric Cables. Engineer, vol. 126, no. 3267, Aug. 9, 1918, p. 116, 3 figs. Description of protective system for use with test sheath cables.

Resistance and Reactance of Iron Transmission Lines, A. Press. Elecn., vol. 81, no. 2097, July 26, 1918, pp. 275-277, 3 figs. A mathematical treatment.

Voltage Regulators. Voltage Regulator for Combined Lamp and Motor Circuits. Electricity, vol. 32, no. 1445, July 19, 1918, p. 379, 4 figs. Circuits and vector relationship of "stabilizer" developed by the General Electric Co.

ENGINEERING MATERIALS

Babbitt Metal. Babbitt Metals: Conservation of Tin. Elec. Power Club, Bul. no. 703, July, 1918, p. 1. Composition of two babbitt mixtures used by the General Electric Co. and of two tin alloys used by Westinghouse Elec. & Mfg. Co.

Bluestone. Methods of Quarrying Bluestone. Stone, vol. 38, no. 8, Aug., 1918, pp. 366-368. Characteristic structure of bluestone; difference between bluestone quarrying and other types.

Boiler Plates. A Cause of Failure in Boiler Plates, W. Rosenhain and D. Hanson. Proc. British Iron & Steel Inst., May 2-3, 1918, Paper no. 15, 12 pp., 18 figs. Results of analysis, mechanical tests and microscopic examination of a boiler plate, 1¾ in. thick, 4 ft. 4 in. wide by 11 ft. long, which failed in the last stage of its manufacture.

Brass. Cast Brass, Its Use and Reclamation, R. C. Brown. Railroad Herald, vol. 22, no. 9, Aug., 1918, pp. 186-187. Suggested scheme to gage service efficiency of the brass account of a railroad.

Bronze (Phosphor). The Manufacture of Phosphor Bronze, W. W. Rogers. Mach. World, vol. 63, no. 1642, June 21, 1918, p. 297. Composition, method of manufacture, and physical properties. From pamphlet published by Stamford. (Conn.) Rolling Mills Co.

Cadmium. The Allotropy of Cadmium, E. Cohen. Jl. Am. Chem. Soc., vol. 40, no. 8, Aug., 1918, pp. 1149-1156, 3 figs. Aiming to demonstrate that in assumptions made by F. H. Getman (vol. 39, 1917, p. 1806), there are errors which when removed make his results identical with those obtained by Cohen and Helderman.

Copper. Copper. Circular of the Bureau of Standards, no. 73, June 25, 1918, pp. 103, 25 figs. Sources, metallurgy, refining and uses of commercial grades; possible allotrophy; chemical and physical properties; casting; deoxidation, working, welding, hardening and electrodeposition; heat treatment; effect of impurities on physical properties; definitions and specifications.

Ferrochrome. Ferrochrome, R. M. Keeney. Colo. School of Mines Mag., vol. 8, no. 8, Aug., 1918, pp. 143-147. Process of manufacturing ferrochrome from domestic fichromite; recovery and carbon control as affected by grade of ore smelted, grade of products desired, and constituents of the charge.

Flint. Domestic Flint Pebbles and Linings Supplant the Foreign. Eng. & Cement World, vol. 13, no. 3, Aug. 1, 1918, pp. 61-62. Sources of grinding pebbles or substitutes thereof produced in the United States during the last few years.

Paving Blocks. Paving Blocks from Kettle River Quarries. Eng. & Cement World, vol. 13, no. 3, Aug. 1, 1918, p. 64. Appearance of rock method employed in quarrying it, and result of analysis.

Sand. Tests Uncover Domestic French Sand Substitute, C. P. Karr. Foundry, vol. 66, no. 313, Sept., 1918, pp. 402-403. Thorough investigation conducted with different molding sands shows Zanesville product closely approaching French sand in desirable qualities.

Scrap Metal. Standard of Classification for Old Metals. Steel & Metal Digest, vol. 8, no. 8, Aug., 1918, pp. 479 and 515. Adopted by the Nat. Assn. of Waste Material Dealers.

Silica. Economic Uses of Silica and Its Occurrence in Eastern Canada, Heber Cole. Iron & Steel Inst. of Canada, vol. 1, no. 7, Aug., 1918, pp. 306-310. Requirements of silica in glass industry; in manufacture of brick, ferro-silicon, sodium silicate; in pottery and enameling; in paint manufacture; for use as a flux; in producing carborundum; in steel foundries.

Stellite. Notes on Stellite (Quelques observations sur "le stellite)", L. Guillet and H. Godfroid. Revue de Métallugie, year 15, no. 4, July-Aug., 1918, pp. 339-346, 7 figs. Physical characteristics; structure; chemical analysis; report of author's tests.

Tantiron. Tantiron. Engineering, vol. 106, no. 2745, Aug. 9, 1918, pp. 154-156, 8 figs. Description of a silica iron used for manufacturing chemists' materials, that resists certain corrosive actions.

Textiles. Investigations on Textile Fibers, W. Harrison. Proc. Roy. Soc., vol. 94, no. A. 663, July 1, 1918, pp. 460-469, 12 figs. Report of investigations on the effect of stress, moisture and heat; probable cause of the double refraction exhibited by natural fibers and effect of chemical treatment on it; experiments with artificial samples to ascertain in what manner internal stresses can arise in fibers.

Zinc. General Congress of the "Genie Civil." Work done by Section IV (Congrès général du Génie civil. Travaux de la Section IV), Demenge and Maneuvrier. Revue Générale de l'Electricité, vol. 4, no. 5, Aug. 3, 1918, pp. 157-161. Report on production and utilization of zinc throughout the world. (Continuation of serial).

New Uses for Zinc, A. P. Cobb. Steel & Iron Digest, vol. 8, no. 8, Aug., 1918, pp. 477-479. Suggestions to dispose of the world's production—greatly increased by the war. Address before Am. Zinc Inst.

FACTORY MANAGEMENT

Cost System. Factory Order and Cost System, W. H. Rohr. Wood-Worker, vol. 37, no. 6, Aug., 1918, pp. 23-25, 7 figs. System designed and operated by Waddell Mfg. Co., Grand Rapids, Mich., manufacturers to order of carvings, turnings, twist work, etc., for interior finish factory trade.

Managership. Under New Management—The Manager. Charles M. Horton. Indus. Management, vol. 65, no. 2, Aug., 1918, pp. 113-116. The human qualities of the manager who will succeed in the immediate future.

Mechanical Handling of Materials. Mechanical Material Handling System Reduces Labor and Hauling Costs and Eliminates Waste in Construction of Michgan Road. Eng. & Contracting, vol. 50, no. 10, Sept. 4, 1918, pp. 233, 4 figs.

Non-Repetitive Work. Managing Non-Repetitive Work, Norman Howard. Indus. Management, vol. 56, no. 2, Aug., 1918, pp. 94-96, 3 figs. How to set times on lathe work in tool making.

Organization. The Spirit of the Organization, William Judson Kibby. Indus. Management, vol. 56, no. 2, Aug., 1918, pp. 117-118. How it is created and sustained.

Rate System. Automatic Rate System Is Fair to All, Harold W. Clapp. Elec. Ry. Jl. vol. 52, no. 6, Aug. 10, 1918, pp. 230-231. A year's experience with a service-at-cost franchise in Westerville, Ohio, shows desirability of flexible fares automatically adjusted.

Railway Stores. Railway Stores Methods and Problems, W. H. Jarvis, Ry. Gaz., vol. 29, nos. 2, 3, 4 and 5, July 12, 19, 26, Aug. 2, 1918, pp. 42-44, 75-78, 102-105 and 130-133, 1 fig. Storage and distribution of material; stores fittings; limitation of stock on hand; standard numbering of items; traffic stores requisitions. (Continuation of serial.)

Economic Factors Connected With Storing. H. B. Twyford. Iron Age, vol. 102, no. 7, Aug. 15, 1918, pp. 395-398, 2 figs. Proper quantities of materials and supplies to keep in stock: consideration of maximum and minimum limits.

Snow Removal. Snow Removal, H. Richards, G. T. Donoghue and W. J. Galligan. Jl. West. Soc. Engrs., vol. 23, no. 3, Mar. ,1918, pp. 175-191. Reports of Chicago commissioners describing work carried out in their respective districts. Paper before Western Soc. of Engrs. Published also in Contract Rec., vol. 32, no. 36, Sept. 4, 1918, p. 720.

Stocks. Fixing Quantities of Materials in Stock, E. W. Taft. Cassier's Eng. Monthly vol. 54, no. 1, July, 1918, pp. 43-45, 1 fig. A method to determine and periodically to revise maxima and minima of materials stocked by industrial concerns.

FORGING

Machine Forging. Machine Forging in Automotive Plants, Automotive Industries, vol. 39, no. 8, Aug. 22, 1918, pp. 327-327. Methods employed in the production of upset or annular forgings.

FOUNDRY

Brass Castings. Expansion and Contraction of Brass Castings, P. W. Blair. Metal Indus., vol. 16, no. 8, Aug., 1918, p. 351. Table of contractions.

Cast-Iron Joints. The Manufacture of Metal Beds, Frank A. Stanley. Am. Mach, vol. 49, no. 10, Sept. 5, 1918, pp. 427-431, 16 figs. Illustrates and describes methods used in pouring cast-iron joints with work set up in assembling fixtures and with chills dor each joint in which parts are gripped and held ready to receive the metal.

Copper Castings. Copper Castings for Electrical Purposes, G. F. Comstock. Brass World, vol. 14, no. 8, Aug. 1918, pp. 229-230. Difficulty of making copper castings of sufficient soundness without decreasing electrical conductivity of the copper.

Cores. Accuracy in Setting Cores, J. V. Hunter. Am. Mach., vol. 49, no. 10, Sept. 5, 1918, pp. 439-440, 3 figs. Methods for supporting cores by walls of flask.

Exceptional Gang Core Boxes, J. V. Hunter. Am. Mach., vol. 49, no. 9, Aug. 29, 1918, pp. 377-380, 10 figs. Description of a method of greatly increasing number of cores in a gang box; gang boxes of "Cook" type.

Deformation of Steel Castings. The Deformation of Steel Castings, T. Brown. Foundry, vol. 66, no. 313 Sept. 1918, pp. 411-413. From paper before British Foundrymen's Assn.

Die Casting. Aluminum-Bronze Die Casting, H. Rix and H. Whitaker. Metal Ind., vol. 1, no. 8, Aug. 1918, pp. 361-363, 1 fig. The effects of iron and manganese on copper-aluminum alloys. A paper before the British Institute of Metals.

Electric Brass Furnace. A Rocking Electric Brass Furnace, H. W. Gillett and A. E. Rhoads. Brass World, vol. 14, no. 18, Aug. 1918, pp. 217-220, 2 figs. Review of electric brass furnaces and description of one used by the Bureau of Mines.

Foundries. How One Steel Foundry Met the Need for Ship and Railway Castings, H. Cole Estep. Foundry, vol. 66, no. 313, Sept. 1918, pp. 415-423, 15 figs. Description of plant of Birdsboro (Pa.) Steel Foundry & Machine Co.

FUEL

CANADA. Fuels of Western Canada, James White. Jl. Eng. Inst. of Canada, vol. 1, no. 4, Aug. 1918, pp. 155-162. Availability of coal, natural gas, petroleum, electricity, peat and wood in Manitoba, Saskatchewan, Alberta and British Columbia.

CHANGE FUEL SYSTEMS. Auxiliary Steam Plant for Seattle, J. H. Longfellow. Jl. of Electricity, vol. 41, no. 4, Aug. 15, 1918, pp. 152-153. Fuel-oil operation with provision for change over to a coal-fired system in new 100,000 kw. installation.

COAL SELECTION. Coal and Its Selection, R. June. Brick & Clay Rec., vol. 53, no. 5, Aug. 27, 1918, pp. 389-392, 4 figs. Classification of coals, graph showing relation of coal to combustion space, influence of moisture, and effect of ash on heating value of Illinois screenings. (Continuation of serial.)

COMBUSTION LOSSES. Management of the Power Plant, Robert June. Textile World Jl., vol. 54, no. 10, Sept 7, 1918, pp. 81-87, 2 figs. Combustion losses and how they may be reduced. (Third of a series. First two in July 6 and Aug. 24 issues.)

EDUCATION OF FIREMEN. Education of Boiler-Room Men Necessary, Edwin A. Hunger. Elec. World, vol. 72, no. 8, Aug. 24, 1918, pp. 344-347. Human element important factor in fuel-conservation efforts; means of fostering interest of firemen; notes on experience of several companies.

FUEL CONSERVATION. Canadian Factory Reduced Coal Bill, B. K. Read. Can. Mfr., vol. 38, no. 9, Sept. 1918, pp. 23-27, 3 figs. Methods adopted and tables of tests on furnaces made by the Dominion Forge & Stamping Co. (To be concluded.)

Coal Conservation in Fact, C. R. Knowles. Contract Rec., vol. 32, no. 36, Sept. 4, 1918, pp. 719-720. Remarks on present waste.

Coal Conservation in New England, Ira N. Hollis. Indus. Management, vol. 56, no. 2, Aug. 1918, pp. 89-93. Outlines Massachusetts plan and scheme of organization to reach every factory and reduce and eliminate the present wastage of fuel.

Coal Saving by the Scientific Control of Steam Boiler Plants, D. Brownlie. Engineering, vol. 106, no. 2741, July 12, 1918, pp. 25-27. Average figures for 250 typical plants covering period from 1910 to the present, showing economy that can be effected by adoption of scientific methods in the boiler-house.

Coal Storage Conservation Rules, W. D. Langtry. Ice & Refrig., vol. 54, no. 5, May 1918, pp. 256-257. Oxidation in storage action of pyrites; spontaneous heating; deterioration; avoiding dangers. Paper before Ill.-Wis. Ice Dealers' Assn.

Conservation of Fuel in California, R. J. C. Wood. Elec. World, vol. 72, no. 8, Aug. 24, 1918, pp. 348-350, 1 fig. By interconnection of systems with different load characteristics one company alone will save nearly a million barrels of fuel oil. Hydro-electric development must continue to meet growing demand for energy.

Fuel Conservation on the Santa Fe, Charles E. Parks. Ry. Rev., vol. 63, no. 4, July 27, 1918, pp. 124-125. Savings of upwards of $2,000,000 made in nine years by the present fuel organization of this road; methods used are explained.

Important Phases of the Fuel Conservation Problem, H. C. Woodbridge. Ry. Age, vol. 65, no. 8, Aug. 23, 1918, pp. 335-336. Suggestions to railway men of all departments regarding economical use of coal. Abstract of paper before Railway Club of Pittsburgh.

Methods for More Efficiently Utilizing Our Fuel Resources. Part XXI. The Coal Fields of the United States, Marius R. Campbell. Gen. Elec. Rev., vol. 21, no. 9, Sept. 1918, pp. 602-619. Detailed statistics of available reserves, present production of each coal region, and map showing all known coal deposits and quality of coal in each region. Abstract from professional paper 100-A, U. S. Geol. Survey, 1917.

Methods for More Efficiently Utilizing Our Fuel Resources, R. H. Fernald. Gen. Elec. Rev., vol. 21, no. 8, Aug. 1918, pp. 542-555, 11 figs. Importance of fuel; statistics of world's coal supply and production; comparative heating values of coal; peat; petroleum and natural gas; conservation.

Reducing Water Waste to Save Coal. Mun. Jl., vol. 43, no. 7, Aug. 17, 1918, pp. 128-129. Figures derived from data obtained in cities of New York; ways by which water waste and leakage can be reduced.

Ways and Means of Saving Coal in the Boiler Room and Shop. Brick & Clay Rec., vol. 53, no. 4, Aug. 13, 1918, pp. 300-301. Recommendations of U. S. Fuel Administration concerning generation and use of power, light and heat.

GAS FUEL. Some Notes on Gas-Firing Boilers, T. M. Hunter. Proc. South Wales Inst. of Engrs., vol. 34, no. 2, July 19, 1918, pp. 127-155, 4 figs. Dry and wet process of gas cleaning; losses involved in boiler firing by gas; essentials for economical combustion and present methods of burning gas; conclusion drawn from a number of experiments upon a Lancashire boiler; tables showing results following upon the combustion of three typical gases, with different quantities of air dilution.

KEROSENE. The Boiling Point of the Paraffins, G. le Bas. Chem. News, vo. 117, no. 3052, July 19, 1918, pp. 241-242. Table showing behavior of compounds in disagreement with Hinrichs-Newmann's rules correlating the boiling point and chemical constitution.

LOW-GRADE FUELS. Sawdust and Wood Burning. Power Plant Eng., vo. 22, no. 16, Aug. 15, 1918, pp. 647-654, 9 figs. A symposium dealing with furnace desings, conditions to maintain, conveying and storage systems, and value of sawdust and wood as fuels.

The Use of Lignite, Bagasse and Wood Waste for Power Generation and Other Purposes, John B. C. Kershaw. Engineer, vol. 126, no. 3267, Aug. 9, 1918, pp. 121-122, 3 figs. Chemical and physical properties of lignite; power generation form air dried lignite; briquetting.

OIL FUEL. France and the Use of Petroleum, M. Henri Berenger. Petroleum Rev., vol. 39, nos. 833 and 834, July 6 and 13, 1918, pp. 11-12 and 27-28. Uses for heating engine boilers; liquid fuel in internal-combustion motors (Diesel type); international problem of petroleum and heavy oils. (Continued from vol. 38, p. 405.)

Petroleum from Coal. Petroleum Rev., vol. 39, no. 838, Aug. 10, 1918, p. 87. Report of committee of Technologist' Instn. on production of oil from cannel coal and allied minerals.

Petroleum Under the Microscope, James Scott. Petroleum World, vol. 15, no. 214, July 1918, pp. 282-283, 3 figs. Some unrefined compounds.

Supply of Oil Available from Shales, G. Egloff and J. C. Morrell. Oil & Gos Jl., vol. 17, nos. 11 and 12, Aug. 16 and 23, 1918, pp. 42-46 and 45-48. Treatment in retorts; comparative yields from oil shales; source of oil shale used; experimental methods; distillation analysis, aromatic hydro-carbons; analysis of water resulting from the thermal decomposition of the oil shale; phenols and its derivatives; heterecyclic nitrogen compounds; compounds isolated from oil-shale retorting.

PEAT. Peat Occurrences in Illinois. Jl. Am. Peat Soc., vol. 11, no. 3, July 1918, pp. 148-152. Results obtained from the Manito (Mason Co.) experiment field on deep peat where treated plots and untreated strips were cropped. Suggestive treatments for different types of peat soils.

Possibilities of Using Peat as Fuel in Some Places. Jl. Am. Peat Soc., vol. 11, no. 3, July 1918, pp. 140-144. Fuel value and method of preparation. From U. S. Geol. Survey Press Bul., June 19, 1918.

Value of Peat Fuel for the Generation of Steam. Engineer, vol. 126, no. 3267, Aug. 9, 1918, pp. 123- 124, 1 fig. Reprint of Bulletin No. 17, Canadian Department of Mines.

PULVERIZED FUEL. General Utilization of Pulverized Coal, Henry G. Barnhurst. Chem. Eng. & Min. Rev., vol. 10, no. 114. March 1918, pp. 174-177. Paper before Cleveland Eng. Soc.

SMOKELESS COMBUSTION. Fuel Economy in the Operation of Hand Fired Power Plants. Contract Rec., vol. 32, no. 27, July 3, 1918, pp. 527-531, 4 figs. Chemical analysis of combustion and discussion of the fundamental conditions necessary for complete and smokeless combustion. From Univ. of Ill. Bul.

Smoke Prevention—Coal Saving Suggestions. Paper, vol. 22, no. 25, Aug. 28 1918, p. 32. Brief outline of suggestions based on long experience of Westinghouse Elec. & Mfg. Co.'s combustion engineers.

STORAGE. Storage and Handling of Gas Coal, H. H. Stoek. Gas Age, vol. 42, no. 4, Aug. 15, 1918, pp. 145-149. Review of investigations by the Experiment Station of the University of Illinois. (To be continued.)

The Storage of Bituminous Coal, with Reference to its Liability to Spontaneous Combustion in Storage Heaps. Bunkers of Cargo. John H. Anderson, Trans. Inst. Marine Engrs., vol. 30, paper no. 236, June 1918, pp. 81-98 and discussion pp. 98-117. Record of methods employed, which so far have given satisfaction.

The Storage of Bituminous Coal, H. H. Stoek. Power Plant Eng., vol. 22, no. 15, Aug. 1, 1918, pp. 614-616, 3 figs. Abstract of paper before Western Soc. of Engrs.

WASTE HEAT. Waste Heat Utilization in Cement Works, H. D. Baylor. Ferro-Concrete, vol. 9, no. 12, June 1918, pp. 430-433, 2 figs. Date obtained with a boiler recently installed by the Louisville Cement Co. From paper before Am. Inst. of Chem. Engrs.

FURNACES

DESIGN. Development of Power from the Standpoint of the Boiler Room, C. F. Hirshfeld. Power, vol. 48, no. 8, Aug. 20, 1918, pp. 284-286, 2 figs. J. E. Alfred Lectures on Engineering Practice, John Hopkins University.

GRAF FURNACE. Graf Gas Consuming Furnace, John Nelson. Iron Age, vol. 102, no. 6, Aug. 8, 1918, p. 339, 1 fig. Air introduced above bridge wall burns gases ordinarily wasted in boilers.

RADIATION FURNACES. Superficial Radiation Furnaces (Fours à radiation superficielle), M. P. Negrier. Revue de Métallurgie, year 15, no. 4, July-Aug. 1918, pp. 391-398, 4 figs. Combustion; scheme of burners and mixers; applications of superficial radiation.

TWO-ZONE FURNACE. The Two-Zone Furnace, O. H. Hertel. Popular Engr., vol. 10, no. 1, July 1918, pp. 26-27. Features of the two-zone boiler furnace.

HEATING

CONDENSATION. Returning Condensation in High and Low-Pressure Heating Systems, Charles L. Hubbard. Domestic Eng., vol. 84, no. 7, Aug. 17, 1918, pp. 236-238, 6 figs. Notes on various methods of saving condensation. (Concluded.)

HOT-WATER HEATING. Expansion of Water in Hot-Water Heating Systems, Howting. Plumbers' Trade Jl., vol. 65, no. 5, Sept. 1, 1918, pp. 277-279, 4 figs. Allowance for expansion in design, construction or installation.

RADIATORS. Meeting the High Cost of Heating and Ventilating Apparatus, George T. Mott. Heat. & Vent. Mag., vol. 15, no. 8, Aug. 1918, pp. 18-24, 3 figs. Advocates use of wall radiators rather than pipe coils as a matter of economy.

ROOM TEMPERATURE. A Study of Degrees of Discomfort. Heat. & Vent. Mag., vol. 15, no. 8, Aug. 1918, pp. 11-14, 1 fig. Based on temperature comfort tests made at Chicago Normal College by Prof. J. W. Shepherd.

SCHOOL BUILDINGS. School Building Heating and Ventilation, Samuel R. Lewis. Heat. & Vent. Mag., vol. 15, no. 8, Aug. 1918, pp. 29-35, 4 figs. First article of series.

HOISTING AND CONVEYING

COAL HANDLING. An Electrically Interlocked Car Haul and Car Feeder, R. P. Hines. Coal Age, vol. 14, no. 7, Aug. 15, 1918, pp. 300-302, 4 figs. A car feeder within the mine and a car haul leading to tipple are so connected electrically that feeder cannot be started until haul is running at normal speed. Both apparatus may be stopped at various points.

Effective System of Coal Handling at Providence, G. K. Jenckes. Gas Age, vol. 42, no. 4, Aug. 15, 1918, p. 158, 1 fig. Extension through use of locomotive crane.

The Britannia Colliery, Pengam, Mon., George Hann. Colliery Guardian vol. 116, no. 3004, July 26, 1918, pp. 173-175, 2 figs. Illustrated description of plant and equipment; all haulage mechanical. From a paper before South Wales Inst. of Engrs.

CONVEYORS. Conveyors for Chemical Works, W. H. Atherton. Cassier's Eng. Monthly, vol. 54, no. 1, July, 1918, Supp. pp. i-viii, 9 figs. Forms and sizes of oxide and coal conveyors. (Contiunation of serial.)

CRANES. Large Navy Floating Crane Made Safe by Regenerative Braking. Elec. Contractor-Dealer, vol. 17, no. 11, Sept. 1918, pp. 100-101, 3 figs. Data of new giant crane said to have lifted a complete tugboat from its berth on the harbor bottom after sinking.

Wall Cranes, E. G. Beck. Mech. World, vol. 64, no. 1646, July 19, 1918, pp. 30-31, 4 figs. Mathematical analysis of a frame under specified loading. (Continuation of a serial; preceding article published May 24.)

ELEVATORS. Factors Governing Elevator Drive, C. E. Clewell. Elec. World, vol. 72, no. 8, Aug. 24, 1918, pp. 340-343, 8 figs. Standand safety features usually embodied in control equipment; power requirements of elevators and types of motor suited to the service; direct- and alternating- current elevator motors.

LIFT CONTROLLERS. Lift Controllers and Controlling Gear for D. C. Lift. Electricity, vol. 32, no. 1445, July 19, 1918, pp. 381-382, 2 figs. Diagrams for car-switch and push-button control systems. (Continuation of serial.)

MARINE RAILWAY. Features of an Electrically Operated Marine Railway. Elec. Rev., vol. 73, no. 8, Aug. 24, 1918, pp. 290-292, 3 figs. Installation on Illinois River served by central-station company; boats carried through channel.

OVERHEAD CARRIERS. Lifeboat Transporting and Lowering Gear, Shipping, vol. 4, no. 7, Aug. 17, 1918, pp. 13-14. Plan and elevations of Ross-Anderson device, consisting of a series of athwartship and fore-and-aft girders carried on columns and forming overhead tracks for trolleys with augnlar pull bearing.

Notes on the Overhead Koepe Winding Plant at Plenmeller Colliery, Haltwhistle, Northumberland, George Raw. Trans. Inst. Min. Engrs., vol. 55, part 3, July 1918, pp. 170-186, and discussion pp. 186-188, 9 figs. Study of operation of plant.

ROPEWAYS. Ropeways in War Time, Telpher. Mech. World, vol. 63, no. 1642, June 21, 1918, pp. 295-296, 9 figs. Explanation of various forms and details of mono-cable and bi-cable lines.

SLAG HAULAGE. Molten Slag Is Hauled by Rail for Making Embankments. Eng. News Rec., vol. 81, no. 6, Aug. 8, 1918, pp. 267-268, 1 fig. Union Railroad at Pittsburgh handles hot materials in ladle cars; fills made in layers prove very substantial.

TRUCKS, INDUSTRIAL. Karry-Lode Industrial Trucks, Tractors and Trailers. Automotive Industries, vol. 39, no. 6, Aug. 8, 1918, pp. 242-243, 3 figs. Trucks employ roller-pinion type of internal drive and are provided with automatic safety switch for use on steamship piers, in railway yards and industrial plants.

Transportation by Power Trucks, Reginald Trautschlod. Indus. Management, vol. 56, no. 2, Aug. 1918, pp. 97-101, 7 figs. Features of a number of types of special trucks for mechanical handling of materials, with paragraphs on operating costs.

TURNTABLES. Bronze Turntable and Movable Bridge Disc, O. E. Selby. Foundry vol. 46, no. 312, Aug. 1918, pp. 368-371. Existing specifications discussed and changes recommended to users and brass foundrymen.

WIRE ROPES. Wire Ropes, "Kinetics". Practical Engr., vol. 58, no. 1638, July 18, 1918, pp. 28-29, 4 figs. Details of construction of guide, rubber and sinking ropes, winding speeds; factors of safety. (Previous articles published Jan. 3, Feb. 14, Mar. 28, May 2 and June 20.)

HYDRAULICS

BAZIN WEIR FORMULA. Verification of the Bazin Weir Formula by Hydro-Chemical Gaugings, C. Herschel. Proc. Am. Soc. Civ. Engrs., vol. 44, no. 6, Aug. 1918, pp. 835-842. Discussion of F. A. Nagler's paper.

CAISSONS, CONCRETE. Concrete Caisson of New Type Used in Breakwater. Eng. New-Rec., vol. 81, no. 6, Aug. 8, 1918, pp. 258-260, 5 figs. Trapezoidal shape adopted for economy: caissons launched, sunk in place and filled to carry monolithic concrete superstructure.

CAST-IRON LININGS OF WELLS. Special Cast Iron Lining of Two Large Bore Wells, W. H. Maxwell. Eng. & Contracting, vol. 50, no. 7, Aug. 14, 1918, pp. 172-175, 3 figs. Reprint from Water and Engineering, London.

DAMS. Facing Leaky Rock-Fill Dam with Timber Planks, George M. Bull. Eng. News-Rec., vol. 81, no. 5, Aug. 1, 1918, pp. 229-231, 2 figs. After dam was raised 25 ft., old concrete facing leaked, so 3 rows of creosoted boards were placed on face.

Improving Arch Action in Arch Dams, W. P. Creager and S. H. Woodward. Proc. Am. Soc. Civ. Engrs., vol. 44, no. 6, Aug. 1918, pp. 871-873. Discussion of L. R. Jorgensen's paper in May issue.

DRAINAGE CHANNELS. Keeping Land Drainage Channels Clear of Growth and Debris in the South, Albert S. Fry. Eng. News-Rec., vol. 81, no. 6, Aug. 8, 1918, pp. 263-266. Experiences in removal of willow and other sprouts and maintaining cross-section in two drainage districts; cost data given.

FLOOD CONTROL. Detention Reservoirs with Spillway Outlets as an Agency in Flood Control, I. E. Honk and K. C. Grant. Proc. Am. Soc. Civ. Engrs., vol. 44, no. 6, Aug. 1918, pp. 827-834, 3 figs. Discussion of paper by the late H. M. Chittenden.

FRICTION IN PIPES. Water Friction in Pipes and Elbows, E. H. Peterson. Ice & Refrig., vol. 54, no. 5, May 1918, pp. 274-275, 2 figs. Charts showing for different sizes the friction loss in pounds per square inch for various capacities in gallons of water per minute.

ICE DIVERSION. Ice Diversion, Hydraulic Models, and Hydraulic Similarity, E. E. R. Tratman and B. F. Groat, Proc. Am. Soc. Civ. Engrs., vol. 44, no. 6, Aug. 1918, pp. 797-822, 3 figs. Theory of hydraulic models; theory of dynamic similarity; factors of safety. Discussion of B. F. Groat's paper.

HYDROELECTRIC INSTALLATIONS. Hydroelectric Development at Rochester, N.Y Street Ry. Bul., vol. 18, 8 Aug. 1918, pp. 349-351, 7 figs. New 25,000-kva. station of the Railway and Light Co., located in the gorge of the Genesee River.

Junction Development Power Plant. Power, vol. 48, no. 8, Aug. 20, 1918, pp. 258-262, 6 figs. Description of 16,500-kw. hydroelectric plant supplying Grand Rapids.

New Plant Added to Michigan System. Elec. World, vol. 72, no. 6, Aug. 10, 1918, pp. 244-248, 6 figs. Description of junction development, the largest hydroelectric plant in Michigan, which is connected with Grand Rapids by 110,000-volt line.

Interesting Small-Capacity Low-Head Hydroelectric Development. Elec. Rev., vol. 73, no. 5, Aug. 3, 1918, pp. 158-160, 5 figs. Description of Geddes plant of 1000-kw. Capacity operating under a working head of 15 ft.

The New Copco Development, C. B. Merrick. Jl. of Electricity, vol. 41, no. 4, Aug. 15, 1918, pp. 150-152. Features of construction and operation of hydroelectric plant at Copco, Cal.

The New 300,000-Hp. Hydro Development. Elec. News, vol. 27, no. 13, July 1, 1918, pp. 36-38, 2 figs. Layout of scheme and cross-section of development works at power house of Chippawa plant, Niagara Falls, Ont.

SHUTTING OFF WATER. Possibilities of Shutting Off Water, M. A. LaVelle. Gas & Oil Jl., vol., 17, no. 8, July 26, 1918, pp. 48-50. Facts on shutting off bottom water by cement in Kansas and Oklahoma wells; use of cement and importance of excluding water from oil wells.

SILT DEPOSITS. Calculating and Preventing Silt Deposits in Reservoirs. F. Droubet. Contract Rec., vol. 32, no. 27, July 3, 1918, pp. 522-523. Results obtained in Switzerland from a study of the geographic and hydraulic conditions of water courses.

STORAGE RESERVOIRS. Determining the Regulating Effect of a Storage Reservoir, Robert E. Horton. Eng. News-Rec., vol. 81, no. 10, Sept. 5, 1918, pp. 455-458, 3 figs. Differential equation for inflow, outflow and storage relations solved by using time interval as independent variable.

WATER WORKS. American Army's Water Works Projects in France Number About Four Hundred, Robert K. Tomlin, Jr. Eng. News-Rec., vol. 81, no. 10, Sept. 5, 1918, pp. 434-437, 5 figs. Great range in size and character of supply; several mechanical filters under way; laboratory division controls quality of water.

Construction of Collection and Transmission System for Marin Municipal Water District. Western Eng., vol. 9, no. 9, Sept. 1918, pp. 355-365, 10 figs. Work done in Marin Co., Cal., containing six towns; system consists mainly of two storage reservoirs with a total capacity of 380,000,000 gal.

Effect of War Conditions Upon Construction, Operation and Maintenance of Water Works. Eng. & Contracting, vol. 50, no. 7, Aug. 14, 1918, pp. 176-177, Findings of special committee of Am. Water Works Assn., with data obtained from about 50 municipally and corporately owned water works in the United States.

Plant Extensions of Public Utilities Financially Considered, John W. Ledoux. Jl. Engrs. Club of Phila., vol., 35-37, no. 164, July 1918, pp. 337-338. Suggestions regarding water-works entensions.

Rural Community Water Supplies, E. L. Miles, Jl. Eng. Inst. of Canada, vol. 1, no. 4, Aug. 1918, pp. 145-150, 3 figs. Account of author's observations while acting as government inspector of water supplies in Province of Saskatchewan. Also published in Can. Engr., vol. 35, no. 7, Aug. 15, 1918, pp. 161-164 and 166, 3 figs. Before Second General Meeting of Eng. Inst. of Can.

The Water Supply of New York. Engineer ,vol. 126, 3267, Aug. 9, 1918, pp. 109-111, 8 figs. Engineering features of dams, tunnels, aqueducts, etc.

War Burdens of Water-Works of United States Increase. Eng. News-Rec., vol 81, no. 7, Aug. 15, 1918, pp. 308-312, 3 figs. From a report to executive committee of Am. Water-Works Assn.

Water-Works Operation. Min. Jl., vol. 45, nos. 6 and 7, Aug. 10 and 17, 1918, pp. 107-108 and 111 and 129-130. Repairing leaks and breaks in water mains and underground appurtenances; preventing recurrence of leaks; leaking valves.

INDUSTRIAL ORGANIZATION

Cost of Service the Chief Factor in Rate Regulation, William G. Raymond. Eng. News-Rec., vol. 81, no. 10, Sept. 5, 1918, pp. 451-454. Rational "fair value" held to be sum of interest on investment and profit on operating expenses, capitalized at "fair return" rate.

Elimination of Idleness by Systematic Study, Charles Whiting Baker. Eng. News-Rec., vol. 81, no. 10, Sept. 5, 1918, pp. 450-451. Graphic chart shows significance of increase in efficiency by reducing machinery idleness amoung industries.

Organization and Co-operation, David J. Champion. Boiler Maker, vol. 18, no. 8, Aug. 1918, pp. 229-231. Trade organization necessary for progress; closer co-operation among boiler manufacturers badly needed. Address before annual convention, Boiler Manufacturers' Assn.

CAPITAL CHARGES. Discussion of Mr. David M. Mowat's Paper on "Capital Charges Considered along with Current Expenses." Trans. Inst. Min. Engrs., vol. 55, part 3, July 1918, pp. 190-195. Paper appeared in Trans. 1917-1918, vol. 54, p. 317 and vol. 55, pp. 54-133.

CITY WAR ORGANIZATION. Milwaukee's Organization for War, Willits Pollock. Indus. Management, vol. 56, no. 2, Aug. 1918, pp. 121-123. Trying out general staff idea in an industrial city.

DEMOBILIZATION. Contract Prices During Demobilization, W. P. Digby. Elecn., vol. 81, no. 2099, Aug. 9, 1918, pp. 308-309, 4 figs. Abstract of paper before Inst. Elec. Engrs. Experience of previous wars; increase in wages and prices of meterials in the past few years.

DEPRECIATION. Some Pitfalls in Regulating Depreciation, John Bauer. Elec. Ry. Jl., vol. 52, no. 8, Aug. 24, 1918, pp. 326-328.

INTERNAL-COMBUSTION ENGINEERING

CARBURETORS. Four New Carburetion Devices. Motor Age, vo. 34, no. 6, Aug. 8, 1918, pp. 40-42, 6 figs. Universal Airgas, Manifold, Hodges and Kerosene Equipment, with their characteristics.

The Carburetor, Technicus, Auto, vol. 33, no. 30, July 26, 1918, pp. 532-534, 2 figs. Technical study of the factors determining its successful operation. (Concluded from p. 516.)

DIESEL ENGINES. Operation of Submarine Diesel Engines, F. C. Sherman. Gas Eng., vol. 20, no. 9, Sept. 1918, pp. 425-429. Causes of troubles and their elimination.

Random Remarks on Modern Marine Diesel Engines, H. R. Setz. Motorship, vol. 3, no. 9, Sept. 1918, pp. 10-12, 7 figs. Effect of length of stroke on efficiency, distinction between mechanical and physical theories, technical details of the new Tosi merchant-marine Diesel engine.

HEAVY OIL ENGINES. The Heavy-Oil Engine, Charles E. Lucke. Engineer, vol. 126, no. 3265, July 26, 1918, pp. 80-83. Its application, tendencies in design. From paper before Engrs.' Club of Phila., Jan. 1918 and printed in Journal of Club, June 1918.

HIGH-SPEED ENGINES. High-Speed Internal Combustion Engines, Harry R. Ricardo. Mech. World, vols. 63 and 64, nos. 1646 and 1647, June 14 and July 26, 1918, p. 284 and pp. 45-46, 1 fig. Features of high-speed engine design. From paper before North-East Coast Inst. of Engrs. and Shipbuilders. (To be continued.)

IGNITION SYSTEM. A Simple Dual Ignition System, G. T. Crouch. Motor Boat, vol. 15, no. 15, Aug. 10, 1918, pp. 22-23, 2 figs. Switch invented by E. S. Brainard, Sacramento, Cal., to use battery and coil with high-tension magneto.

INDIVIDUAL TYPES. Buda Model "H T U" Engine. Automotive Industries, vol. 39, no. 7, Aug. 15, 1918, pp. 282-283, 5 figs. Model with detachable cylinder head, force-feed lubrication, special crankcase construction, heavier flywheel for tractor use, and vaporizing manifold for burning kerosene, designed for truck and tractor service

Kahlenburg Heavy-Oil Engine. Motorship, vol. 3, no. 9, Spet. 1918, p. 13, 1 fig. General features of motor of the surface-ignition class built at Two Rivers, Wis.

The Possibilities of the Hvid Engine. Nat. Gas Engine Assn. Bul., vol. 4, no. 2, Sept. 1918, pp. 6-17. Discussion of paper by E. B. Blakely, published in Aug. Bulletin.

KNOCKING. Knocking in Gas Engines. Practical Engr., vol. 58, no. 1538, July 18, 1918, pp. 31-32. Significance and possible causes.

MULTIPLE VALVES. Increasing the Engine's Volumetric Efficiency, Morris A. Hill. Automotive Eng., vol 3, no. 7, Aug. 1918, pp. 295-297, 5 figs. Further comment on multiple valves and designs which aim to give multiple-valve effect without its numerous parts. (Ffth of serie.)

PULVERIZERS. Oil-Engine Sprayers or Pulverizers. A. H. Goldingham and C. T. O'Brien. Motorship, vol. 3, no. 9, Sept. 1918, p.p. 19-20, 4 figs. Desceription of four types. (Continued.)

SUB-PISTONS. Gile Engine Employs Sub-Piston. Automotive Industries, vol. 39, no. 6, Aug. 8, 1918, pp. 229 and 238, 2 figs. Longitudinal and cross-sections of engine designed to work on two-stroke principle, with piston-controlled port for inlet and a poppet valve in the head for exhaust.

TURBINES. Internal Combustion Turbines. Practical Engr., vol. 58, no. 1639, July 25, 1918, pp. 40-42, 10 figs. Some types of gas turbines.

IRON

(See Steel and Iron)

LABOR

BETHLEHEM AWARD. Labor Board's Award in Bethlehem Case, Iron Age, vol. 102, no. 6, Aug. 8, 1918, pp. 326-327. Text of finding in case of machinists and electrical workers vs. Bethlehem Steel Co.

BUSINESS MANAGEMENT. Significant Changes in Business Management. Am. Mach., vol. 49, no. 5, Aug. 1, 1918, pp. 191,193. Suggestions regarding policy to meet changes in relations between capital and labor.

HOUSING. Company Residences for Railroad Employees, C. B. & Q. R. R. Ry., vol. 63, no. 6, Aug. 10, 1918, pp. 197-200, 6 figs. Description with plans of cottages and rooming houses.

LABOR COSTS. Report on Estimating Labor Costs. Elec. Rev., vol. 73, no. 4, July 27, 1918, pp. 125-131. 7 figs. Compiled by the Electrical Estimators' Assn. of Chicago and presented at the Cleveland Convention of the National Assn. of Electrical Contractors and Dealers.

NEGROES. Negroes a Source of Industrial Labor. Dwight Thompson Farnham. Indus. Management, vol. 56, no. 2, Aug. 1918, pp. 123-129, 10 figs. Experiences of author with this type of labor.

PIECEWORK RATES. Determining of Piecework Rates from Charts, Otto M. Burkhardt. Am. Mach., vol. 49, no. 9, Aug. 29, 1918. pp. 383-387, 6 charts. A simple method of figuring piecework prices by means of charts when the necessary time elements are known.

RAILROAD EMPLOYEES. Classification, Working Conditions and Wages of Mechanical Department Employees. Ry. Rev., vol. 63, no. 5, Aug. 3, 1918, pp. 154-157, Supplement no. 4 to general order no. 27, Director General of Railroads.

TRAINING. Intensive Training in an Aircraft Plant, Frank L. Glynn. Automotive Industries, vol 39, no. 9, Aug. 29, 1918, 7 figs. Curtiss Co.'s school has capacity of 200 to 300 operatives per week. Women develop skill after short instruction period.

Steel Plant Educates Foreign Employees. Blast Burnace & Steel Plant, vol. 6, no. 9, Sept. 1918, pp. 384,385. Youngstown Sheet & Tube Co. establishes system of free schools primarily for educating and Americanizing foreign-born employees in all parts of the mills.

The Training of Engineers, E. J. Silcock. Czn. Engr., vol. 35, nos. 6 and 7, Aug. 8,and 15, 1918, pp. 138-140 and p. 150. Scope of education of civil engineer and amount of specialization necessary for those who intend to practice as water-works engineers. Paper before Inst. Water Engrs., England. Published also in Surveyor, vol. 54, no. 1381, July 5, 1918, pp. 3-4.

Training Metallurgists in Schools and Metallurgical Works, H. C. H. Carpenter. Can. Min. Jl., vol. 39, no. 14, July 15, 1918, pp. 246-248, Extracts from presidential address, Inst. of Metals, London, March 1918.

Training 150 Operators Per Week. Automotive Industries, vol. 39, no. 7, Aug. 15, 1918, pp. 277-280. How the vestibule school of Remington Arms Company is meeting the demand for skilled workers of both sexes; how operatives are routed through plant.

WOMEN. Employment of Women in Munition Factories. Jl. Inst. Mech. Engrs., no. 5, June 1918, pp. 223-238. Records of several plants presented by members of Institute.

The Efficient Utilization of Labor in Engineering Factories, B. H. Morgan. Jl. Inst. Mech. Engrs., no. 5, June 1918, pp. 239-265. Special reference to women's work.

Women in Railway Work. Ry. Rev., vol. 63, no. 4, July 27, 1918, pp. 122-123, 4 figs. Women employed by railways in various capacities.

LIGHTING (Illumination)

AUTOMOBILE PPANTS. Improved Lighting of Automobile Manufacturing Plants, F. H. Bernhard. Elec. Rev., vol. 73, no. 6, Aug. 10, 1918, pp. 205-211, 12 figs. Advisability of utilizing latest lighting developments; features that need special improvement.

EDISON LAMPS. Edison Mazda Lamps for Protective Lighting. Edison Lamp Wks. of Gen. Elec. Co., Bul. no. 43,412, July 1918, pp. 1-14, 26 figs. Application of contrast to protective lighting; glare; available apparatus; sketches illutrating arrangement in various systems.

ILLUMINATION. Fundamentals of Illumination Design, Ward Harrison. Gen. Elec. Rev., vol. 21, no. 8, Aug. 1918, pp. 535-541, 10 figs. Solution of problems covering the lighting requirements of a large general office, the main floor of a clothing store, a furniture factory, and an industrial plant manufacturing tools and other similar metal parts. (Concluded.)

INDIRECT LIGHTING. Illumination, Harold W. Brown. Elec. Contractor-Dealer, vol. 17, no. 11, Sept. 1918, pp. 86-91, 23 figs. Applications of indirect lighting to hospitals, churches, reading rooms, stores and houses.

LAWS ON LIGHTING. Laws Regulating Insufficient Lighting, Chesla C. Sherlock. Am. Mach., vol. 49, no. 9, Aug. 29, 1918. pp. 381,382. Résumé of some court findings.

PRINTING PLANTS. The Lighting of Printing and Book-Binding Plants, F. H. Bernhard. Elec. Rev., vol. 73, no. 8, Aug. 24, 1918, pp. 279-286, 11 figs. Importance of best possible lighting to printer; general eatures of lighting problem and suggestions for effective illumination of principal departments.

WAR CONSERVATION. Lighting Curtailment, Preston S. Miller. Jl. Engrs.' Club, Phila., vol. 35-8, no. 165, Aug. 1918, pp. 381-3891 and (discussion) pp. 391-399, 2 figs. Considers that since coal used in production of electric light is less than 2 per cent of total output of country and standards of illumination intensity before the war were in general too low, it is practicable to effect much larger savings by other methods with less disadvantage to the public.

War Conservation of Power and Light, Chas. E. Stuart. Jl. Engrs.' Club, Phila., vol. 35-8, no. 165, Aug. 1918, pp. 400-403. Practical scheme of operations of power and light division of U. S. Fuel Administration.

LUBRICATION

SELECTION. Important Factors in Choosing Lubricants, F. H. Conradson. Petroleum Rev., vol. 39, no. 838, Aug. 10, 1918, pp. 85-86. Lubrication problems in connection with new designs, service conditions and requirements.

MACHINE PARTS

BALL BEARINGS. Ball Bearings for Machine Shop Equipment, Edward K. Hammond. Machy., vol. 94, no. 12, Aug. 1918, pp. 1097-1103, 6 figs. Discusses the advantages of ball bearings, their construction, lubrication, design of mountings and felt packings.

Ball-Races in Machine Tools, J. Horner. Mech. World, vol. 64, no. 1646, July 19, 1918, pp. 26-27, 6 figs. Application of Skefko ball bearings to various machines. (Continuation of a serial; preceding article published June 28.)

BELTS. Belts for Driving High-Speed Cutterheads. Wood-Worker, vol. 37, no. 6, Aug. 1918, pp. 40-41, 2 figs. Suggestions recommending light double belts for this service.

GEARS. A Note on Spiral Gears. Mech. World, vol. 64, no. 1647, July 26, 1918, p. 39, 1 fig. Suggestions in calculation of engine gears.

Gear Standardization, B. F. Waterman. Machy., Market, nos. 926 and 927, Aug. 2 and 9, 1918, pp. 17 and 19. General aspect of the problem; application of standards, worm making; inspection committee. Abstract of paper before Am. Gear Mfrs.' Assn.

Strength of Spiral Type Bevel Gears, Reginald Trautschold. Mach., vol. 24, no. 12, Aug. 1918, pp. 1111-1115, 2 figs. Formulæ for determining strength of spiral type bevel gears.

Thermal Refinement of Gear Blanks, C. R. Poole. Page's Eng. Weekly, vol. 33, no. 724, July 26, 1918, p. 41. Difference between carbonized and heat-treated types of gears. Paper before Am. Gear Mfrs.' Assn.

MACHINE SHOP

BALANCING. Dynamic Balancing of Rotating Sections, Carl Hering. Elec. World, vol. 72, no. 9, Aug. 31, 1918, pp. 389-390, 1 fig. Dynamic balancing additional to static balance; rational unit for expressing and measuring the tolerance allowed.

BLACKSMITH SHOP. The Engineer's Smith, Joseph Horner. Mech. World, vol. 63, no. 1642, June 21, 1918, p. 294, 2 figs. Character of the layout, and nature of the practice of present day shops. (To be continued.)

BOLT MAKING. Bolt Manufacture in Railway Shops, M. H. Williams. Ry. Mech., Eng., vol. 92, no. 8, Aug. 1918, pp. 465-470, 7 figs. Consideration of methods and tools necessary for rapid production.

CHATTER MARKS. Elimination of Chatter Marks from Machined Work. Am. Mach., vol. 49, no. 8, Aug. 22, 1918, pp. 349-354, 11 figs. Some of the main causes of chatter marks and means taken to eliminate them.

CRANK REPAIRS. Crank Repairs, C. E. Anderson. Power Plant Eng., vol. 22, no. 16, Aug. 15, 1918, pp. 667-669, 4 figs. Difficulties encountered and remedies employed.

Cutting of Metals. Cutting Heavy Forging Ingots, W. B. Perdue. Jl. Acetylene Welding, vol. 2, no. 2, Aug. 1918, pp. [illegible], 2 figs. Methods used by Jackson Mfg. Co., Gadsden, [illegible].

The Cutting of Cast Iron with Oxygen. Acetylene & Welding Jl., vol. 15, no. 177, June 1918, pp. [illegible], 2 figs. Table of [illegible] results from a series of [illegible].

The Cutting of Iron and Steel by Oxygen, M. R. Anceau (Translated from original French by D. Richardson). Acetylene & Welding Jl., vol. 15, no. 177, June 1918, pp. 102-[illegible], [illegible] figs. Macrophotographs showing decarburization of metal with central jet oxy-acetylene cutting blowpipe. (Continuation of serial.)

Drilling-Machine Work. Unusual Operations on Drilling Machines, Edward K. Hammond. Machy., vol. 24, no. 12, Aug. 1918, pp. 1091-1093, 6 figs. Use of drilling machines for such operations as driving tools and assembling.

Foil Manufacture. The Manufacture of Tin and Lead Foil, L. J. Krom. Metal Indus., vol. 16, no. 8, Aug. 1918, pp. 352-354, 7 figs. Brief illustrated description of process.

Friction Clutch. Manufacturing the Johnson Friction Clutch. Am. Mach., vol. 49, no. 6, Aug. 8, 1918, pp. 263-266, 11 figs. Details of manufacturing operations.

Gages. Flush-Pin Versus Limit Gages, Albert H. Dowd. Am. Mach., vol. 49, no. 7, Aug. 15, 1918, pp. 283-284, 5 figs. Describes several types of flush-pin gages both for work and inspection and gives examples of their use.

Indicating Fixtures for the Gaging of Automobile Parts, Albert A. Dowd. Am. Mach., vo. 49, no. 7, Aug. 15, 1918, pp. 299-302, 5 figs. Description of several indicating gages.

Surface Gage with Fine Adjustments, J. G. J. Mech. World, vol. 64, no. 1646, July 19, 1918, p. 27, 1 fig. Sketch of a surface gage with adjustment for height.

Galvanizing Sheets. Modern Practice in Galvanizing Sheets, Clement F. Poppleton. Iron Age, vol. 102, no. 8, Aug. 22, 1918, pp. 433-436, 2 figs. Methods of constructing and operating galvanizing pots; preparation of material and costs; some hitherto unpublished facts.

Gas-Engine Construction. Gas Engine Work on the Pacific Coast, Frank A. Stanley. Am. Mach., vol. 49, no. 8, Aug. 22, 1918, pp. 343-347, 17 figs. Description of certain operations in making marine and stationery engines.

Machining Pistons, Flywheel and Cylinders of Gasoline Engines, M. E. Hoag. Am. Mach., vol. 49, no. 10, Sept. 5, 1918, pp. 443-444, 5 figs. Work of Potter & Johnson automatics with special fixtures and tooling.

Heat Treatment. Effect of Mass on Heat Treatment, E. F. Law. Proc. British Iron & Steel Inst., May 2-3, 1918, Paper no. 16, 15 pp., 17 figs. Report of experiments: Sets of heating and cooling curves of 18-in. cubes, each weighing 14½ cwts., heated to a temperature of 1650 deg. fahr. and allowed to remain in the furnace for 4½ hr.; microphotographs of sections cut from test-pieces representing the steel cube from outside to center; survey of results obtained by other investigators; conclusions and further experiments on 12-in. cubes.

Electric Furnace for Heat Treating Small Airplaine Parts, Dwight D. Miller. Am. Mach., vol. 49, no. 9, Aug. 29, 1918, pp. 373-376, 2 figs. Description of electric furnace for heat-treating metal parts and operations involved.

Electric Treatment of Airplane Forgings, Dwight D. Miller. Iron Age, vol. 102, no. 7, Aug. 15, 1918, pp. 381-385, 4 figs. Details of Bailey furnace for heat-treating axle forgings at plant of Ingalls-Shepard Forging Co.

Time Effect in Tempering Steel, A. E. Bellis. Ry. Jl., vol. 24, no. 8, Aug. 1918, pp. 27-28. Report of tests made on rifle-barrel steel. Abstract of A. I. M.E. paper.

Hobbing. Charts Giving Time Required to Hob Spur Gears, V. P. Rumley. Machy., vol. 24, no. 12, Aug. 1918, pp. 1085-1086, 2 charts.

Hobs and Hobbing, F. G. Hoffman, Mech. World, vol. 64, no. 1646, July 19, 1918, pp. 27-28. Proposed ideal system of cutting gears developped from a study of the various methods in use at present. Am. Gear Mfrs. Assn. paper.

Reclamation Work. Connecticut Company Centralizes Reclamation Work at New Haven. Elec. Ry. Jl., vol. 52, no. 9, Aug. 31, 1918, pp. 364-367, 14 figs. By segregating heavy repairs, manufacturing operations and reclaiming of damaged equipment this company has achieved substantial economies.

Rubber Insulators. Moulds for Hard Rubber Insulators, Effero. India-Rubber Jl., vol. 56, nos. 1, 2 and 3, July 6, 13 and 20, 1918, pp. 9-10, 33-34, 16 figs, and 57-61, 8 figs. Design features of the rotating distributor arm and stationery carbon holder for the high tension magneto. (Serial.)

Sand Blast. Sand-Blast Operation, D. Evans. Mech. World, vol. 64, no. 1646, July 19, 1918, p. 32, 4 figs. Pressure required for cleaning steel; description of four types of sand-blast equipment. (To be continued.)

Screw Cutting. Cutting and Verifying Accurate Screw Threads (La taille et la correction des vis de précision), Génie Civil, vol. 73, no. 5, Aug. 3, 1918, pp. 81-84, 10 figs. Bryant Symons screw-cutting lathe.

Screw-Cutting Simply Explained for Munition Workers, G. Gentry. Model Engr. & Elecn., vol. 39, no. 899, July 18, 1918, pp. 37-38. Calculating wheels for cutting metric threads on metric lathes and on English lathes. (Continuation of serial.)

Shafting Brackets. Hanger and Bracket Fixings for Rolled-Steel Joists, F. R. Parsons. Mech. World, vol. 64, no. 1646, July 19, 1918, p. 31, 9 figs. Suggested methods of attaching shafting brackets, hangers, bearings; idler or gallows pulleys to rolled-steel joists, in such a manner as will permit a certain amount of latitude of adjustment in order to bring them and the shafting into alignment.

Welding. A. C. Arc Welding and Cutting. Automotive industries, vol. 39, no. 6, Aug. 8, 1918, p. 241, 1 fig. Light-weight machine of Electric Arc Cutting & Welding Co., Newark, N.J., consisting of a special transformer with no moving parts.

Bibliography of Electric Welding, 1918-1914, William F. Jacob. Gen. Elec. Rev., vol. 21, no. 9, Sept. 1918, pp. 652-658. Includes references to theory, various uses, methods of application and costs.

Boiler Repairs by Electric Welding, R. S. Kennedy. Boiler Maker, vol. 18, no. 8, Aug. 1918, pp. 225-227. Development of arc-welding process; description of process to boiler repairs. From paper before Inst. of Marine Engrs., London.

Electric Arc Welding, A. M. Candy. Proc. Am. Inst. Elec. Engrs., vol. 37, no. 9, Sept. 1918, pp. 1159-1171, 21 figs. History of process; present practice; manipulation of arc and weld; carbon vs. metallic electrodes.

My Method of Welding with the Electric Arc and Work Which I Have Done, E. D. Johnson. Boiler Maker, vol. 18, no. 8, Aug. 1918, pp. 219-222, 14 figs. Suggestions from author's nine years' experience.

The Autogenous Welding of Lead (Lead Burning), P. Rosenberg. Acetylene & Welding Jl., vol. 15, no. 177, June 1918, pp. 100-101, 5 figs. History of the manufacture of sulphuric acid and of autogenous welding. Enumeration of four processes for lead: hydrogen and air, hydrogen and oxygen, acetylene and air, acetylene and oxiygen. (To be continued.)

The Relation to Welding Problems of the Properties of Iron and Steel and Their Heat Treatment. Jl. Acetylene Welding, vol. 2, no. 2, Aug. 1918, pp. 74-76. Difficulties in welding cast iron and suggested remedies to overcome them. (Continuation of serial.)

Welded Seams and Connections Correct Faults in Big Converters. Jl. Acetylene Welding, vol. 2, no. 2, Aug. 1918, pp. 70;73, 9 figs. Details of operation in welding a flange to a cotton converter.

Welding Methods at Columbus Shop. Ry. Mech. Eng., vol. 92, no. 8, Aug. 1918, pp. 473-474, 4 figs. Carbon and metallic arc welding both used; special building erected for welding.

Welding Truck Side Frames, Bolsters and Arch Bars. Ry. Jl., vol. 24, no. 8, Aug. 1918, pp. 23-24. Committee report before M. C. B. Assn.

METAL AND WORKING MACHINERY

Band Saw. Vertical Log Band Saw. Engineering, vol. 106, no. 2745, Aug. 9, 1918, p. 146, fig 1. Description and principal data of a vertical log band saw constructed by A. Ransome & Co., Ltd.

Cam Profiles. Cam Profiles (1). W. K. Wilson. Mech. World, vol. 64, no. 1647, July 26, 1918, pp. 43-44, 3 figs. Investigation of effect a modification of cam profile can produce upon inertia pressure to which valve gear is subject. (To be continued.)

Drilling Spindles. A Vertical Slide and Drilling Spindle for the 2-in. Precision Lathe, C. H. C. Copeland. Model Engr., vol. 39, no. 898, July 11, 1918, pp. 19-21, 2 figs. Details of design.

Planers. Some New Ideas in Planer Practice. Woodworker, vol. 37, no. 6, Aug. 1918, pp. 26-27, 3 figs. Suggests advisability of shifting more of the feeding gear below the cutterhead so that it may pull the stock instead of pushing it, also slightly beveling the infeed edge of the bedplate under the cutterhead of single surfacers.

Portable Machines. Taking Machines to the Work Edward K. Hammond. Machy., vo. 24, no. 12, Aug. 1918, pp. 1073-1081, 23 figs. Methods of applying portable machines in performance of shop operations, and advantages thus secured.

Presses. Ferracute Press. Am. Mach., vol. 49, no. 10, Sept. 15, 1918, p. 450, 1 fig. Description with dimensions and other data of a single-action power press recently redesigned by the Ferracute Machine Co., Bridgeton, N.J., adapted for cutting and forming sheet-metal work of large area, such as coal hods, metal shingles, etc.

Propeller-Shaping Machine. Aero-Propeller Shaping Machine. Engineer, vol. 126, no. 3264, July 19,1918, p. 60, 2 figs. Description of a machine for shaping aero propellers made by A. Ransome & Co., Ltd , Newark-on-Trent.

Railway Shop. Machine Tools and Appliances in Railway Workshops. Ry. Gaz., vol. 29, no. 5, Aug. 2, 1918, pp. 134-138, 8 figs. Illustrates and describes improvements in designs and types effected during the last 50 years.

Shell-Drilling Machine. Special Shell-Drilling Machines, Donald A. Baker. Machy., vol. 24, no. 12, Aug. 1918, pp. 1131-1132, 4 figs.

Tool Slide. A Tool Slide for the Drummond 4-in. or Similar Lathe, W. Baker. Model Engr. & Electn., vol. 39, no. 899, July 18, 1918, pp. 29-31, 3 figs. Details of design.

Wheel-Forcing Machine. A new Wheel-Forcing Machine. Ry. Gaz., vol. 29, no. 4, July 26, 1918, p. 105. Product of Hollings & Guest, Birmingham, for removing heavy Foden and similar wagon wheels.

Wooden Dies. Using a Punch Press in Lieu of Bending Rolls, J. V. Hunter. Am. Mach., vol. 49, no. 6, Aug. 8, 1918. pp. 243-245, 6 figs. Wooden dies and punch press used to accomplish some awkward bending jobs.

MARINE ENGINEERING

Concrete Ships. Concrete Barges, Louis L. Brown. Int. Mar. Eng., vol. 23, no. 8, Aug. 1918, pp. 450-452, 8 figs. Brief description of design, method of construction, materials used, method of waterproofing and launching. From a paper before Am. Contre Inst., June 1918.

Concrete Barges Designed for New York State Barge Canal. Eng. News-Rec., vol. 81, no. 6, Aug. 8, 1918, pp. 271-272, 4 figs. Shipping Board prepares plans for 500-ton towboats to be operated by Federal Railroad Administration.

Concrete Ship of 3,500 Tons Deadweight Designed by Emergency Fleet Corporation. Int. Mar. Eng., vol. 23, no. 8, Aug. 1918, pp. 446-449, 9 figs Conclusions of the Concrete Ship Department; details of the standard ship.

Design and Construction of Self-Propelled Reinforced Concrete Seagoing Cargo Steamers Now Building in Great Britain, T. G. Owens Thurston. Int. Mar. Eng., vol. 23, no. 8, Aug. 1918, pp. 455-464, 15 figs. Paper before Inst. of Naval Architects, London March 1918.

Progress in the application of Concrete to Barge and Shipbuilding, J. E. Freeman. Jl. West. Soc. Engrs., vol. 23, no. 3, Mar. 1918, pp. 205-220. Review of progress in concrete-boat buidling from its earliest inception; discussion of the various problems entering into application of reinforced concrete to such construction.

Reinforced Concrete Tugs (Les remorqueurs en béton armé), G. Espitallier. Génie Civil, vol. 73, no. 4, July 27, 1918, pp. 61-64, 14 figs. Type Pelnard-Considère, Caquot & Co.; principles for computation of dimensions; protection; prevention of leaks.

Seagoing Reinforced Concrete Ships. Sogaende Jarnbetonskibe, H. Glyming. Ingenioren, vol. 27, no. 58, July 20, 1918, pp. 413-416.

The Building of Concrete Barges, E. L. Livingston. Contract Rec., vol. 32, no. 32, Aug. 7, 1918, pp. 629-630. Methods recently employed at New York. Before the Am. Concrete Inst.

The Building of Concrete Ships. Contract Rec., vol. 32, no. 33, Aug. 14, 1918, pp. 646-647. Am. Concrete Inst. paper.

The Design of Concrete Ships, H. Dexter. Western Eng., vol. 9, no. 9, Sept. 1918, pp. 345-358, 27 figs. Formulae and curves.

Control Mechanism. Mechanical Interlock Between Telegraph and Main Engine Control Lever. Shipbuilding and Shipping Rec., vol. 12, no. 4, July 25, 1918, pp. 83-84, 1 fig. Mechanism to prevent the engine control lever being moved in contradiction to the telegraph indication.

Corrosion. Corrosion of Ships. Nautical Gaz., vol. 94, no. 8, Aug. 24, 1918, p. 89. Causes and protectors. From Liverpool Jl. of Commerce.

Deadrise Cruisers. Model Experiments on Express Cruisers of Deadrise Type, T. A. Gamon. Int. Mar. Eng., vol. 23, no. 8, Aug. 1918, pp. 473-476, 7 figs. For high-speed length ratio deadrise type proves superior to round bilge model; resistance of appendage investigated.

Electric Fittings. Construction and Uses of Marine Electrical Fittings. Elec. Rec., vol. 24, no. 3, Sept. 1918, pp. 61-66, 25 figs. Details of fittings and illustrations of typical, special and standardized types.

Furness Company's Shipyard. A New Furness Shipyard. Engineering, vol. 106, no. 2743, July 26, 1918, p. 82, 9 figs. Short notice of new enterprise, with illustrations of the work in progress. Also published in Engineer, vol. 26, no. 3265, July 26, 1918, pp. 73-74, 7 figs.

Hog Island. A Record of Achievements at Hog Islands, W. H. Blood, Jr. Elec. Rev., vol. 73, no. 5, Aug. 3, 1918, pp. 155-157, 4 figs. Statistics on the work in progress and results already secured.

Launching. End-Launching of Vessel in Narrow Stream, Max Hausen. Int. Mar. Eng., vol. 23, no. 8, Aug. 1918, pp. 469-470, 1 fig. Vessel started down ways at high velocity and brought to a standstill at end of ways by means of a brake.

Motorships. Novel Large British "Diesel"-Driven Tanker. Motorship, vol. 3, no. 9, Sept. 1918, pp. 14-15, 2 figs. General dimension of Santa Margharita, a motorship of 11,000 tons d-w-c., fitted with a solid injection Vickers oil engines of 2,500 b. hp. and with auxiliary motors of 1,150 b.hp.

The Australian Motorship "Cethana." Motorship, vol. 3, no. 9, Sept. 1918, p. 15. Details of acceptance trials of American-built Diesel engined wooden merchant vessel of the single well-deck type.

Trials of M. S. "Alabama." Motorship, vol. 3, no. 9, Sept. 1918, p. 21. Speed tests of new 1,000-b.hp. Diesel-driven vessel of 4,000 tons deadweight capacity.

Repairs. Emergency Repairs to a Battleship. Shipbuilding & Shipping Rec., vol. 12, no. 5, Aug. 1, 1918, pp. 113-115. Details of work involved in substitution by the engine-room staff of the "Arkansas," of an electric motor for the wrecked starboard main circulating pump.

Reversing Rudders. Reversing and Control Rudder. The Rudder, vol. 34, no. 9, Sept. 1918, pp. 436-437, 7 figs. Experiments with a 25-ft. power boat showing the possibility of eliminating reversing turbines from turbine-propelled ships.

Rivetless Ship. See Welded Ships, below.

Submarines. Propelling Machinery for Submarine Boats (in Japanese), Genjiro Hamabe. Jl. Soc. M. E., Tokyo, vol. 21, no. 53, July 1918.

Tuckahoe. The Building of the "Tuckahce," E. A. Suverkrop. Am. Mach., vol. 49, no. 7, Aug. 15, 1918, pp. 278-281, 10 figs. Record of the progress in building this 5,500-ton collier in 27 days.

Turbo-Electric Propulsion. Electric Propulsion of Ships, Eskil Berg. Int. Mar. Eng., vol. 23, no. 8, Aug. 1918, pp. 477-479. Results obtained with electric drive on the "Jupiter"; installations for battleships and cruisers.

The Ljungström Turbo-Electric System of Ship Propulsion. Engineering, vol. 106, no. 2471, July 12, 1918, pp. 30-31, 16 figs. Description of the radial-flow steam turbines built for S. S. Wulsty Castle.

Welded Ships. An Electrically Welded Barge. Engineering, vol. 106, no. 2745, Aug. 9, 1918, p. 142, 2 figs. Description of experimental rivetless ship constructed in Great Britain.

Britain's First Rivetless Ship. Nautical Gaz., vol. 94, no. 7, Aug 17, 1918, p. 79. Discussion of possibilities and claimed disadvantages of the electric welding process.

Electrically-Welded Barge. Engineer, vol. 126, no. 3267, Aug. 9, 1918, pp. 122-123, 2 figs. Description of 275-ton rivetless barge constructed in Great Britain.

Electrically-Welded Ships. Elecn., vol. 81, no. 2099, Aug. 9, 1918, pp 319-320, 1 fig. Description of experimental 275-ton rivetless barge constructed in Great Britain.

MATHEMATICS

Closed Curves. On Closed Curves Described by a Spherical Pendulum, Arnold Emch. Proc. Nat. Acad. of Science, vol. 4, no. 8, Aug. 1918, pp. 218-221. Results of analytical investigation of properties of these curves.

Hypergeometric Functions. The Practical Importance of the Confluent Hypergeometric Function, H. A. Webb and J. R. Airey. Lond., Edingurgh & Dublin & Phil. Mag., vol. 36, no. 211, July 1918, pp. 129-144, 10 figs. Tables and graph designs, differential equations solvable by means of these, and properties of the functions used in constructing the tables.

Single-Side Surface. A Surface Having Only a Single Side, C. Hering. Jl. Franklin Inst., vol. 186, no. 2, Aug. 1918, pp. 233-241, 13 figs. Equation and analytical investigation of the properties of a surface generated by a line moving along a circle, always remaining in plates passing through the axis of the circle and simultaneously revolving around the circle as its axis at half the angular rate of its movement along the circle.

Theory of Numbers. Arithmetical Theory of Certain Hurwitzian Continued Fractions, D. N. Leamer. Proc. Nat. Acad. of Sci., vol. 4, no. 8, Aug. 1918, pp. 214-218. Arithmetical study of series of numbers which satisfy certain difference equation.

On the Representation of a Number as the Sum of any Number of Squares, and in Particular of Five or Seven, C. H. Hardy. Proc. Nat. Academy of Sciences, vol. 4, no. 7, July 15, 1918, pp. 189-193. Research to deduce formulæ for s = 5 and s = 7 from the theory of elliptic function.

MECHANICS

Beams. Distribution of Internal Work in Beams and Slabs, Henry T. Eddy. Eng. News-Rec., vol. 81, no. 10, Sept. 5, 1918, pp. 460-462. The Difference in amount of energy stored in steel indicates dissimilarity in structural functions of Concrete.

Long Span Concrete Beams Should Have Fixed Ends, W. S. Tait. Eng. News-Rec., vol. 81, no. 8, Aug. 22, 1918, pp. 359-361, 5 figs. Method given by which computated of rigid frame may be readily made.

Maximum Positions of Moving Loads on Beams, F. K. E. Mech. World, vol. 64, no. 1646, July 19, 1918, 0p. 31, 1 fig. Information for finding the maximum bending moments and shears on beams due to the action of loads moving over them. From a paper read before the Inst. or local Government engineers. of Australia.

Columns and Struts. Discussion on Final Report of the Special Committee on Steel Columns and Struts, W. H. Burr and R. von Fabrice. Proc. Am. Soc. Civ. Engrs., vol. 44, no. 6, Aug. 1918, pp. 875-895, 4 figs. Comparison of committee's results with present practice. (Concluded.)

Disks, Rotating The Strength of Rotating Disks, H. Haerle, Engineering, vol. 106, no. 2745, Aug. 9, 1918, pp. 131-134, 8 figs. A mathematical treatment applied to steam turines.

Dynamics. The Fundamentals of Dynamics, W. S. Franklin and B. MacNutt. Science, vol. 48, no. 1231, Aug. 2, 1918, pp. 113-116. Criticism of Prof. E. V. Huntington's discussions of elementary mechanics in Mar. 3, 1916, issue.

Earth Pressures. Computing Lateral Pressure of Saturated Earth, A. G. Husted. Eng. News-Rec., vol. 81, no. 10, Sept. 5, 1918, pp. 441-442, 2 figs. Proposed method takes account of separation of hydrostatic from earth pressure, but, allows full hydrostatic pressure.

Gyroscopic Phenomena. On Stability Phenomena in a Ship Gyroscope and Single Rail Railroads (Om Stabilitetsfaenomeneme ved Skibsgyroskopet og Enskinnebanen), A. Bendixsen. Ingenioren, vol. 27, no. 56, July 13, 1918, pp. 399-406, 5 figs.

Indeterminate Structures. Equivalent Uniform Loads for Indeterminate Structures, D. B. Steinman. Eng. News-Rec., vol. 81, no. 5, Aug. 1, 1918, pp. 231-232, 3 figs. Method worked out for ordinary trusses applied to curve influence lines; wheel-load complications avoided.

Truss Members. Effect of Initial Stress on Redundant Truss Members, H. T. Booth. Aviation, vol. 5, no. 2, Aug. 15, 1918, pp. 91-93, 3 figs. Equations for the calculation of load stresses in diagonal tension braces when an initial tension is present; example of the action when diagonals are similar; illustration of the stress calculation for redundant members, with initial tension in two of them.

METAL ORES

Manganese. Manganese, M. A. Allen and G. M. Butler. Univ. of Ariz. Bul. no. 91, Aug. 1918, 32 pp. Composition of manganese minerals — Psilomelane, pyrolusite, manganite, wad, braunite, rhodochrosite, rhodonite and alabandite; tests for manganese; occurrence and origin of ores; Arizona deposits; uses; manufacture of alloys.

Radium. Radium Ore Deposits, Richard B. Moore. Eng. & Min. Jl., vol. 106, no. 9, Aug. 31, 1918, pp. 392-393. From paper before Colorado meeting of Am. Inst. of Min. Engr., Sept. 1918.

Rare Metals. Rare Earths and Rare Minerals. Eng. & Cement World, vol. 13, no. 3, Aug. 1, 1918, p. 78. Chief ores and uses of zirconium; method of refining graphite; preparation of ground mica.

Sulphur. Sulphur and Pyrites in 1917, Philip S. Smith. Am. Fertilizer, vol. 49, no. 4, Aug. 17, 1918, pp. 36-42 and 56-82. Production, imports, exports and character of domestic deposits of sulphur; qualities ,uses, production and deposits of pyrites in the United States.

War Ores. War Materials of Colorado, A. H. Hubbell. Eng. & Min. Jl., vol. 106, no. 9, Aug. 31, 1918, pp. 382-384. Lead, zinc, gold, silver, tungsten and copper ores. Uranium, vanadium and radium produced from carnotite, vanadinite and pitchblende ores.

METALLURGY

Alloys. Some Miscellaneous Allows Made by the Metal and Thermit Cooperation. Reactions, vol. 11, no. 2, Second Quarter 1918, pp. 29-30. Uses of phosphor copper, phosphor tin, manganese titanium, manganese boron, silicon copper, chromium copper, cobalt copper, nickel copper, vanadium copper, titanium copper and manganese aluminum.

Brass Rolling. Chemistry of the Brass Rolling Mill, or the Relation of the Chemical Laboratory to the Brass Rolling Mill, M. B. Karr. Iron & Steel Inst. of Canada, vol. 1, no. 7, Aug. 1918, pp. 297-299. Significance of chemical control. Paper before Montreal Metallurgical Assn.

Rolling of Brass (Laminado del laton), J. Borrell Macia. Revista Minera, year 69, no. 2645, June 24, 1918, pp. 309-313, 7 figs. Microstructure; composition of alloy for cold-rolling.

Non-Ferrous Alloys. Metallography Applied to Non-Ferrous Metals, Ernest J. Davis. Foundry, vol. 66, no. 313, Sept. 1918, pp. 427-429, 5 figs. Elementary article dealing with the science embracing a study of the internal structure of metals and alloys.

The Constitution and Influence of a Cored Dendritic Structure in Alloys, O. Smalley. Jl. Soc. Chem. Industry, vol. 37, no. 13, July 15, 1918, pp. 191 T-200 T and discussion 200 T-201 T, 22 figs. Causes of microstructure, relation of composition and structure to physical properties, influence of varying casting temperature on properties of phosphor bronze castings poured from the same melt; effect of heat treatment on properties of Admiralty gun metal, influence of impurities on properties of 70:30 brass before and after removal of the cast structure; relation of impurities to ghosts.

Stibnite Smelting. Blast Furnace Smelting of Stibnite. Eng. & Min. Jl., vol. 106, no. 5, Aug. 3, 1918, pp. 211-216, 1 fig. Details of experimentation, showing effects of varying flux charge; minimum economic limit of coke required.

MILITARY ENGINEERING

Anti-Aircraft Firing. The Problem of Anti-Aircraft Firing, X. Bollé. Jl. Wash. Academy of Sci., vol. 8, no. 14, Aug. 19, 1918, pp. 465-480, 8 figs. Technical study of the general problems which anti-aircraft warfare has presented to the minds of artillerymen.

Artillery. Developments in Artillery During the War, J. Headlam. Sci. Am. Supp., vol. 85, no. 2215, June 15, 1918, pp. 370-371. How the changes in tactics affect technical matters and how the demands of the soldier may upset the plans of the scientist. (To be continued.)

Ballistics. Internal Ballistics, A. G. Hadcock. Proc. Royal Soc., vol. 94, no. A663, July 1, 1918, pp. 479-509, 6 figs. Explanation and illustration of method for obtaining pressure-volume relation of gases in the bore of a gun from the instant of ignition of charge to the instant when shot leaves the gun, and mathematical expressions to plot the indicator diagram of charge when its nature and weight are known.

MINES AND MINING

Cementation. Cementation Process Applied to Mining, A. H. Krynauw. Colliery Guardian, vol. 116, no. 3005, Aug. 2, 1918, pp. 227-229, 9 figs. From paper before Chemical, Metallurgical & Min. Soc. of South Africa, May 1918.

Drilling. A Gasoline-Driven Diamond Drill Outfit, J. M. Longyear, Jr. Eng. & min. Jl., vol. 106, no. 8, Aug. 24, 1918, pp. 343-345. Nearly 7,000 ft. of holes put down at a total cost of $2,152 per ft.; easily portable apparatus.

Fires. Mine Fire at Utah-Apex Mine, V. S. Rood and J. A. Norden. Safety Eng., vol. 35, no. 6, June 1918, pp. 356-364, 3 figs. Geology, mining methods and conditions of workings; condition during and after the fire; results of analyses of air at different openings. Proc., A. I. M. E., Utah Section.

Some Results of Analysis of Airs from a Mine Fire., A. G. Blakeley and H. H. Reist. Jl. Indus. & Eng. Chem., vol. 10, no. 7, July 1, 1918, pp. 552-553. Data from samples taken at an anthracite coal mine generating a large quantity of methane.

Shafts. Shafts for Water Hoisting and Ventilation. Coal Age, vol. 14, no. 9, Aug. 29, 1918, pp. 397-400, 8 figs. "Water seal" permits shaft to be used for both ventilation and water hoisting. Description of first installation in United States.

Steel Guides in Shafts, J. Whitehouse. Jl. of South African Inst. of Engrs., vol. 16, no. 11, June 1918, pp. 200-204, 5 figs. Results obtained by the use of slotted steel guides in the turf shaft of the Village Deep Mine; suggested system for replacing guides.

Sprayers. Sprayer for Stone-Dusting in Mines, A. Rushton. Trans. Inst. Min. Engrs., vol. 55, part 3, July 1918, pp. 219-220, and discussion pp. 220-221. T-shaped wrought-iron-tubing apparaus operated by compressed air.

Washing. Recuperation of Combustible from Slag and Wash Residium (Récupération du combustible utilisable dans les scories et résidus de lavage). L'Echo des Mines et de la Métallurgie, no. 2581, July 7, 1918. Treatment of slag from metallurgical furnaces; washing of schists from mining installations.

MOTOR-CAR ENGINEERING

Ambulances. U. S. A. Ambulance and Trailer. Automotive Industries, vol. 39, no. 4, July 25, 1918, pp. 152-155, pp. 148-149, 3 figs. Review of specifications for an ambulance body for the class A A or G. M. C. ¾ ton chassis. Details of the spare-parts trailer and field litter.

Headlights. Automobile Headlights and Glare-Reducting Devices, L. C. Potter. Gen. Elec. Rev., vol. 21, no. 9, Sept. 1918, pp. 627-632, 13 figs. Discussion of underlying principles of causes of glares; devices to prevent glare.

Omnibus. Omnibus Selection by Tests. Tramway & Ry. World, vol. 44, no. 2, July 11, 1918, p. 39, 1 fig. Specifications of 19-30 passenger type supplied to San Francisco Council.

Piston Displacement. Piston Displacement Chart for Four-Cylinder Engines, Any Bore and Stroke. Motor Age, vol. 34, no. 9, Aug. 29, 1918, p. 38. Gives piston displacement in cubic inches with 0.01 cu. in. limit of error.

Tractors. An Improved Chain Track for Tractors. Automotive Industries, vol. 39, no. 7, Aug. 15, 1918, p. 280, 2 figs. Chain of sheet-steel sections having guided rocking joints with dust encluder and exclosed track carrier, developed by Ralph Wishon, of San Francisco, Cal.

Steering Creeper and Two-Wheeled Tractors, A. C. Woodbury. Automotive Industries, vol. 39, no. 7, Aug. 15, 1918, pp. 269-270, 2 figs. Outline of various plans for steering tractors by other methods than that involved in Ackermann steering axle.

The Latest Electric Tractor. Auto, vol. 33, no. 30, July 26, 1918, pp. 535-536, 2 figs. Three-Wheeled couple-gear tractor designed to do the same work as a horse team at greater speeds.

The Peoria Kerosene Tractor. Automotive Industries, vol. 39, no. 9, Aug. 29, 1918, pp. 366-367, 4 figs. Assembled of parts produced in specialized plants. Engine, clutch and transmission bolted together. Deawbar hitch can be laterally adjusted from driver's seat.

Tractor Gear Ratio Chart. Automotive Industries, vol. 39, no. 9, Aug. 29, 1918, p. 372. Diagram of curves to find gear reduction to give a certain tractor speed with a given engine speed and drive-wheel diameter.

Tractor Speed in Plowing, Fred M. Loomis. Motor Age, vol. 34, no. 9, Aug. 29, 1918, pp. 5-8, 3 figs. Study of effect of speed and soil conditions on plow draft and tractor drawbar pull.

Trucks. English and American Motor Oil Tank Trucks, Frank C. Perkins. Gas Eng., vol. 20, no. 9, Sept. 1918, pp. 413-417, 11 figs. Data and descriptions of several types.

Wheels. Making Cast Steel Wheels for U. S. Army Trucks. Foundry, Vol. 66, no. 313, Sept. 1918, pp. 396-401, 11 figs. Description of processes at Dayton Steel Foundry Co.

Wood Wheels Preferred by the Majority, C. N. Bonbright. Auto. Topics, vol. 50, no. 11, July 20, 1918, pp. 1102-1103 and 1107. Discussion of merits of materials for automobile wheels.

MUNITIONS

Ansaldo Munitions Factory. Ansaldo Steel Plants Rush Munitions, Mario de Biasi, Blast Furnace & Steel Plant, vol. 6, no. 9, Sept. 1918, 4 pp., following 358, 12 figs. Gio Ansaldo & Co., employing over 100,000 men, manufacture guns, cannon, shells, aeroplanes, submarines, merchant and battleships.

Bullets. Resistance of Copper Crushers During Compression, H. W. R. Mason, Arms & Explosives, vol. 26, no. 310, July 1, 1918, pp. 90-92. Description of tests and tables of results.

Cunard Shell Factory. The Cunard National Shell Factory. Engineering, vol. 106, no. 2740, July 5, 1918, pp. 3-6, 26 figs. Illustrated description of the work, the machines and tools used and certain fixtures.

Field Guns. The 75-Mm. Field Gun, Model 1916, M. III, Special Correspondence. Am. Mach., vol. 49, no. 8, Aug. 22, 1918, pp. 323-328, 4 figs. Description of latest type of 75-mm. field gun built by U. S. Government.

Howitzers, 6-in., British. The British 6-in. Howitzer, I. William Chubb. Am. Mach., vol. 49, no. 6, Aug. 8, 1918, pp. 231-242, 24 figs. First of a series on gun-making and repairing in English privately owned shops. Part II. in Am. Mach., vol. 49, no. 10, Sept. 5, 1918, pp. 411-423, 6 figs. Machining and heat-treating of jacket; assembling howitzer; fitting of new A-tubes and repair of damaged howitzers.

Madsen Automatic Gun. The Madsen Automatic Gun. Sci. Am. Supp., vol. 86, no. 2224, Aug. 17, 1918, pp. 108-110, 6 figs. Details of weapon for which great efficiency is claimed. From the Engineer (London).

Marine Torpedoes. Early History of the Marine Torpedo, H. H. Manchester. Am. Mach., vol. 49, no. 10, Sept. 5, 1918, pp. 435-438, 11 figs. Historical sketch of prototype of modern topedo, commencing with earliest known type, in 1285 and dealing with Bushnell's torpedo, 1810.

Naval Gun Cars. Gun Transport Car for the Navy. Ry. Mech. Eng., vol. 92, no. 8, Aug. 1918, pp. 457-459, 4 figs. Details of special car for transporting 16-in. guns.

Special Cars for Transporting Heavy Naval Guns. Ry. Age, vol. 65, no. 5, Aug. 2, 1918. pp. 212-214, 4 figs. Details and drawings.

Revolvers. Revolvers and Automatic Pistols (Les revolvers et les pistolets automatiques). L. Cabanes. Génie Civil, vol. 73, no. 4, July 27, 1918, pp. 64-67, 10 figs. Recent developments in manufacture of French type, Nagant Russian and Austro-Hungarian, no. 1898. (To be continued.)

Shell, 18-lb., British. Special Machine-Tool Fixtures for Making the British 18-lb. Shell, Chester B. Hamilton, Jr. Am. Mach., vol. 49, no. 9, Aug. 29, 1918, pp. 395-396, 5 figs.

PAINTS AND FINISHES

Ironwork. Corrosion of Ironwork, J. N. Friend. Surveyor, vol. 54, no. 1384, July 26, 1918, p. 43. Summary of results of author's researches on the usefulness of paint for protecting ironwork. Abstract of paper before Iron & Steel Inst. Also published in Can. Engr., vol. 35, no. 7, Aug. 15, 1918, p. 149.

Paint and Its Application to Railway Structures. Eng. Rev., vol. 32, no. 1, July 15, 1918, pp. 20-21. Preservative and decorative purposes of the industry. From report of Com. of Am. Ry. Bridge and Building Assn.

Standards for Protective Finishes for Iron, E. P. Later. Foundry, vo.l 66, no. 313, Sept. 1918, pp. 424-426. Results of series of tests which indicate protective qualities of various metals and thickness of coatings.

PHYSICS

Air. Physics of the Air, W. J. . Humphreys. Jl. Franklin Inst., vol. 186, no. 2, Aug. 1918, pp. 211-232, 5 figs. Rocket, ball, sheet, beaded, return and dark lightning; length of streak; nature of the discharge; temperature; visibility; spectrum; thunder; rumbling; cerannograph; chemical effects; explosive effects. (Continuation of serial.)

Electrolytes. Colloidal Electrolytes: Soap Solutions as a Type, J. W. McBain. Jl. Soc. Chem. Industry, vol. 37, no. 14, July 31, 1918, pp. 249 T-252 T. Results of experiments on the constitution, hydrolysis, conductivity, osmotic properties and viscosity of soap solutions.

Electronic Frequency. Electric Frequency and Atomic Number, Paul D. Foote, Phys. Rev., vol. 12, no. 2, Aug. 1918, pp. 115-121. Examination of Dr. Allen's formula for relation between atomic frequency and Moseley's atomic number, in the light of data on ionization potentials recently published by Franck, Davis, Bazzoni, Tate, Foote and Hughes.

Emulsions. Water-in-Oil Emulsions, A. U. Max Schlaepfer. Jl. Chem. Soc., vols. 113 and 114, no. 668, June 1918, pp. 522-526. Experiments performed with the aid of a finely divided solid, insoluble in both liquids, which is more easily wetted by the oil than by the water phase.

Flame Propagation in Gases. Flame Propagation in Gaseous Mixtures, G. A. Burrell and A. W. Ganger. Sci. & Art of Min., vol. 28, no. 26, July 27, 1918, p. 475. From technical paper 150 summarizing experiments of U. S. Bureau of Mines on limits of complete inflammability of mixtures of mine gases, etc.

Optics. On the Correction of Optical Surfaces, A. A. Michelson. Proc. Nat. Academy of Sciences, vol. 4, no. 7, July 15, 1918, pp. 211-212. Suggested modifications in Mr. Twyman's interferometer method.

Transmission of Light Through Water, S. J. E. Rose. Gen. Elec. Rev., vol. 21, no. 8, Aug. 1918, pp. 577-578, 2 figs. Table of experimental values of transmission factor T in the equation $I = Io + Tf$ where Io is the initial intensity and I the intensity after passing through f feet of water.

Polarization. Polarization in Case of Moving Electrodes, Carl Barus. Science, vol. 48, no. 1236, Sept. 6, 1918, pp. 253-254. Experiments at Brown University in which a strong residual polarization in direction of charging current was obtained; elucidation of phenomenon.

Reciprocity. Law of Reciprocity (Loi de réciprocité), J. B. Pomey. Revue Générale de l'Electricité, vol. 4, no. 5, Aug. 3, 1918, pp. 131-132. Equation derived from the principle of virtual velocities, between the electromotive force ek in each of the branches of a network and the function of the derivatioe of the energy with respect to the current gk; also reciprocal equation for the current in terms of the derivatives with respect to the electromotive forces.

Relativity. General Relativity Without the Equivalence Hypothesis, L. Silberstein. Lond., Edinburgh & Dublin Phil. Mag., vol. 36, no. 211, July 1918, pp. 94-128. Chief aspects and illustrations of the physical implications of the principle of relativity as proposed by Einstein, but without placing gravitation in connection with the fundamental tensor which appears in the line-element of the world.

Spectra. Extreme Ultra-Violet Spectra of Hot Sparks in High Vacua, R. A. Millikan and R. A. Sawyer. Phys. Rev., vol. 12, no. 2, Aug. 1918, pp. 167-170, 1 figs. Report of experiments. Abstract of paper before New York Meeting, Am. Phys. Soc.

Structural Matter. On the Dynamics of the Electron, M. Nad Saha. Lond., Edinburgh & Dublin Phil. Mag., vol. 36, no. 211, July 1918, pp. 76-87. Theory aiming at the formulation of the dynamics of the electron without following the preconceived ideas of classical mechanics. Reasoning is based on Lorentz's Theorum of ponderomotive force and the principle of relativity.

Some Properties of Metals Under the Influence of Alpha Rays, A. G. McGougan. Phys. Rev., vol. 12, no. 2, Aug. 1918, pp. 122-129, 4 figs. Yale University experimental research involving: An attempt to present a fresh clean surface of metal to incident x-rays by scraping the surface of the metal, while in a high vacuum; similar experiment for a surface of mercury by method of overflow, thereby stretching the surface film and producing a new clean surface of mercury.

Surface Friction. Surface Friction of Fluids, E. Parry. New Zealand Jl. of Sci. & Technology, vol. 1, no. 3, May 1918, pp. 154-156, Proposes general law of fluid friction: For geomatrically similar surfaces R/pr^2 is a function of $vl/^2$, where R is the resistance per unit of area, p the density of fluid, v the relative velocity, la dimension of the surface, and v the kinematic viscosity; deductions from experimental data in regard to flow of water in pipes.

Vibrations. On Ship-Waves, and on Waves in Deep Water Due to the motion of Submerged Bodies, G. Green. Lond., Edinburgh & Dublin Phil. Mag., vol. 36, no. 211, July 1918, pp. 48-63. Extension of Lord Kelvin's method for determining wave motion to any arbitrary conditions of applied surface pressure: discussion of the wave disturbance due to a cylinder and a sphere moving with constant velocity at a considerable depth beneath the surface.

Variably-Coupled Vibrations—Both Masses and Periods Unequal. E. H. Barton and H. M. Browning. Lond., Edinburgh & Dublin Phil. Mag., vol. 36, no. 211, July 1918, pp. 36-47. Theory of general case for double cord pendulum and experimental results. (Continued from Oct. 1917 and Jan.. 1918 issues.)

Vibration: Mechanical, Musical and Electrical. Nature, vol. 101, no. 2545, Aug. 8, 1918, pp. 456-459, 5 figs. Brass instruments and the low " F "; monochord vibrations; violin vibrations. (Concluded.)

PIPE

Costs. Cost of Laying Iron Pipe. Mun. Jl., vol. 45, no. 6, Aug. 10, 1918, pp. 111-112. Unit figures for estimating cost under various conditions as to size, depth of trench and costs of material and labor.

Clay Pipe, Vitrified. The Use of Vitrified Clay Pipe for Irrigation Lines, V. E. Piollet. Mun. & County Eng., vol. 55, no. 2, Aug. 1918, pp. 73-75. Requirements of construction.

Curved Pipe. Stresses in Curved Pipes, J. S. Henzell. Mech. World, vol. 64, no. 1646, July 19, 1918, pp. 28-29, 1 fig. Analytical study of the stresses in pipes which suffer external restraint. (Continuation of serial; preceding article published July 5.)

Joints. Methods of Making Sewer Pipe Joints, Contract Rec., vol. 32, no. 36, Sept. 4, 1918, pp. 718-719. Specifications for several joints. From discussion before Boston Soc. Civ. Engrs.

New Concrete Pipe Joint Designed for High Pressure, Eng. News-Rec., vol. 81, no. 5, Aug. 1, 1918, p. 216, 1 fig Joint proves watertight under tests for heads up to 250 ft.; can be used for diameters as small as 4 in.

Pressure Pipe. Recent Developments in Reinforced Concrete Pressure Pipe for Water Supply Lines, W. R. Harris. Mun. & County Eng., vol. 55, no. 2, Aug. 1918, pp. 58-59, 3 figs. Present maximum working pressure; structural features; types of expansion joints.

The Choice of Material for Pressure Pipes, Ralph Bennett. Jl. of Electricity, vol. 41, no. 3, Aug. 1, 1918, pp. 123-124. Study of available types (steel, concrete, wood stave.)

Welded Pipe. The Manufacture of Welded Pipe, S. A. Hand. Am. Mach., vol. 49, no. 7, Aug. 15, 1918, pp. 285-288, 7 figs. Description of methods used by National Tube Co.

POWER GENERATION AND SELECTION

Aqueduct Construction. Construction of Famous Aqueduct Facilitated by Electricity, C. W. Geiger. Elec. Rev., vol. 73, no. 7, Aug. 17, 1918, pp. 241-242, 5 figs. Description of use of electricity in building the Los Angeles Aqueduct.

Auxiliaries Drive. Motor Driven Auxiliaries (I), C. Grant. Mech. World, vol. 63, no. 1641, June 14, 1918, p. 283. Comparison between turbine and electric-motor drives. (To be continued.)

Costs. Economic Proportion of Hydroelectric and Steam Power, Frank G. Baum, Proc. Am. Inst. Elec. Engrs., vol. 37, no. 9, Sept. 1918, pp. 1115-1119, 2 figs. Method for obtaining a curve showing "Total cost per kilowatt-year for hydro-electric and steam power" for any precentage combination of generation.

Electric Power Generation. A Review of Recent Electrical Engineering Progress, E. W. Rice, Jr. Elec. News, vol. 27, no. 16, Aug. 15, 1918, pp. 25-28. Efficiency in converting water to electric power; improvements in steam-producing devices; possibility of further advances in steam-turbo-electric unit; elements in the efficiency problem; linking of plants for exchange of power; electric furnace; electrification and transportation. Presidential address, A. I. E. E. convention.

Mills, Continuous. Operation of Motor-Driven Continuous Mills, H. C. Cronk. Blast Furnace & Steel Plant, vol. 6, no. 8, Aug. 1918, pp. 336-338. Operating data giving power consumption per ton, including auxiliary motors. Paper before Cleveland Section, Assn. Iron & Steel Elec. Engrs.

Mining. Electrical Manufacturers May Look to Metal Mining for Greater Output, W. A. Scott. Elec. Rev., vol. 73, no. 4, July 27, 1918, pp. 119-120, 3 figs. Present demand for metals creates increased mining activity: steadily widening field for electrical equipment and electric power in the metal mines.

Electricity in Coal Mining Operations, Frank Huskinson. Elec. Rev., vol. 73, nos. 7 and 8, Aug. 17 and 24, 1918, pp. 245-247, 8 figs., and 287-289, 6 figs. Mine haulage by electric locomotives; electric rotary drills, electric blasting; advantages of electric service.

How Electrical Methods Are Speeding Up Coal Mining Operations (III). T. R. Hay. Elec. Rec., vol. 24, no. 3, Sept. 1918, pp.. 2829, 8 figs. Details of manner in which electrical equipment is used inside and about the mine; electric mine hoists; pumping equipment; ventilating system; miscellaneous uses of electrical energy.

The Consideration of Items of Practical Importance in Connection with Mining Electrical Engineering, Chris. Jones. Proc. South Wales Inst. of Engrs., vol. 34, no. 2, July 19, 1918, pp. 159-206, 24 figs. Considerations, curves and data regarding the efficiency and cost of generating, distributing and applying: electrical power in mines and kindred industries; periodicity of supply; power factor; earthed and insulated neutral; reactance; cables; transformers; earthing.

Tire Manufacture. Electricity in the Manufacture of Automobile Tires, B. B. Jackson. Elec. Rev., vol. 73, no. 4, July 27, 1918, pp. 121-124, 5 figs. Process of tire making choices of motors and salient features of control, applying especially to plant of International India Rubber Co., South Bend, Ind.

Woodworking Machinery. Motor Drive for Woodworking Machinery, C. E. Clewell. Elec. World, vol. 72, no. 6, Aug. 10, 1918, pp. 253-256, 4 figs. Induction motors used extensively for timber sawing and planing; power requirements of typical machines; examples of successful motor applications.

POWER PLANTS

Rand Plant. Turbine House Plant Operation, with Special Reference to the Rand Power Companies' Plants, T. G. Otley and V. Pickles. Trans. South African Inst. Elec. Engrs., vol. 9, part 5, May 1918, pp. 68-88, 11 figs. Discussion of some points in connection with efficient operation of turbine plant and its attendant auxiliaries.

Shaft Drive. More Power from Shaft by Use of Turbine. Elec. News, vol. 27, no. 15, Aug. 1, 1918, p. 33. General features of shaft drive, consisting of a low-pressure turbine and a Daubee reduction gear, recently installed in a Western Pennsylvania paper mill.

Small Power Plant. How to Manage Small Power Plants, W. T. Wardale. Model Engr. & Elecn., vol. 39, nos. 890 and 900, July 18 and 25, 1918, pp. 34-35, 2 figs, and pp. 47-48, 6 figs. Requirements of pump water gland packing; manner of packing. (Continuation of serial.)

Winona Plant. The New 5000-Kilowatt Station at Winona, Minn. Elec. Rev., vol. 73, no. 9, Aug. 31, 1918, pp. 321-324, 4 figs. Mechanical and electrical features of Wisconsin Railway, Light and Power Co.'s plant.

PRODUCER GAS AND GAS PRODUCERS

Suggestions for Gas Producer Operation, F. Denk. Blast Furnace & Steel Plant, vol. 6, no. 9, Sept. 1918, pp. 386-388, 5 figs. Tests and curves showing relations of factors influencing operation; depth and position of ash bed determined by unique device; careful attention essential in successful operation.

PUMPS

Air lift. Performance of New Air-Lift. Pumping Plant at Galesburg, Ill., J. Oliphant. Mun. & County Eng., vol. 55, no. 2, Aug. 1918, pp. 57-58. Conditions of operation and results of tests.

Deep-Well Pump. Importance of Diameter of Deep Wells. Mun. Jl., vol. 45, no. 6, Aug. 10, 1918, pp. 105-107. Where deep-well pumps are used, diameter of well limits size of pump; lower part may be of smaller diameter.

Lift Pumps. Lift and Force Pumps, John H. Perry. Domestic Eng., vol. 84, no. 7, Aug. 17, 1918, pp. 239-241, 5 figs. Construction and operation of pumps with steady flow and high efficiency.

Mine Pump. Handling Mine Water, Henry E. Cole. Coal Age, vol. 14, no. 6, Aug. 8, 1918, pp. 264-266, 2 figs. Work pump must perform; character of water; types of pumps.

TURBINE PUMP. Pumping Equipment at Thorold, Ont., W. J. Adams. Can. Engr., vol. 35, no. 6, Aug. 8, 1918, pp. 121-122. New installation consisting of a two-stage 1500-gal. turbine pump directly connected to a 250-hp. induction motor with control and auxiliary apparatus.

RAILROAD ENGINEERING, ELECTRIC

CIRCUIT BREAKERS. High Speed Circuit Breaker for Chicago, Milwaukee & St. Paul Electrification, C. H. Hill. Gen. Elec. Rev., vol. 21, no. 9, Sept. 1918, pp. 624-626, 5 figs. Gives details of construction.

ELECTRIFICATION. Electrification of New York Connecting Railway. Ry. Gaz., vol. 29, no. 3, July 19, 1918, pp. 81-84. Method of operation, trolley supporting structure, catenary trolly system, communication lines, transmission line.

Norfolk and Western Electrification Helping Directly to Win the War. Elec. Ry. Jl., vol. 52, no. 8, Aug. 24, 1918, pp. 322-325, 5 figs. Fifty per cent. increase in mountain grade capacity through electrification.

Tendencies in Electrification, L. A. Palmer. Ry. Rev., vol. 63, no. 5, Aug. 3, 1918, pp. 176-178. Brief resumé of the leading steam railway electrification projects in the United States. From a paper before Pacific Coast Railway Club, June 1918.

The Electrification of the Chicago, Milwaukee & St. Paul Railway, A. E. du Pasquier. Trans. S. A. Inst. E. E., June 1918, pp. 94-126, 18 figs. Criticism of E. W. Kirkland's paper published in July and Aug. 1918 journals under same title; other railway electrification data in connection with Kirkland's inferences.

The Electrification of the Chicago, Milwaukee & St. Paul Ry., R. Beeuwkes. Elec. Ry. & Tramway Jl., vol. 39, no. 932, Aug. 9, 1918, pp. 42-46, 5 figs. Regeneration on down grade, engineering and construction, results of operation; comparison of train delays and of steam and electric locomotive performance. (Continued from July 12 issue.)

HEATING OF CARS. Why Not Use Wasted Energy to Help Heat Cars? Elec. Ry. Jl., vol. 52, no. 7, Aug. 17, 1918, pp. 291-292, 2 figs. Possibilities of utilizing heat from car motors and resistance grids discussed and results of some tests given.

LINE CONSTRUCTION. Applying Common-Sense in Line Construction, Charles R. Harte. Elec. Ry. Jl., vol. 52, no. 7, Aug. 17, 1918, pp. 278-282, 14 figs. Money and time can be saved by close co-operation of designer and constructor, and by attention to details commonly overlooked.

LOCOMOTIVE CONTROL. A New Type of Mine Locomotive Control, L. W. Webb. Gen. Elec. Rev., vol. 21, no. 9, Sept. 1918, pp. 620-622, 8 figs. A controller developed for use on large mine locomotives where the capacity of hand-operated drum controls would be exceeded. Wiring connections of two, three and four-motor controllers.

METERING POWER. Study of Car Energy Saving at Dubuque, L. E. Gould. Elec. Ry. Jl., vol. 52, no. 8, Aug. 24, 1918, pp. 334-336, 4 figs. Tests made on level and hill lines show that savings as high as 26 per cent. can be obtained by the use of meters as checking devices.

OPERATION. High Passenger Density the Outstanding Feature of New Service to Hog Island. Elec. Ry. Jl., vol. 52, no. 10, Sept. 7, 1918, pp. 404-408, 8 figs. Details and data of Philadelphia Rapid Transit Co.'s cars, including new features of door control.

Increased Economy Results from Correct Operation of car Equipment, C. W. Squier. Elec. Ry. Jl., vol. 52, no. 7, Aug. 17, 1918, pp. 275-277, 4 figs. Effects of various rates of acceleration and braking on the schedule speeds and power consumed; relation of number of stops and their length to cost of operation.

Selling Transportation on a Commercial Basis, Clarence Renshaw. Elec. Ry. Jl., vol. 52, no. 10, Sept. 7, 1918, pp. 415-416. Sale methods of other lines of business apply to electric railways; some requisites for good service.

SECTION CARS. Gasoline Motor Section Cars Decrease Labor and Cost of Track Maintenance, Clifford A. Elliott. Elec. Ry. Jl., vol. 52, no. 10, Sept. 7, 1918, p. 423, 3 figs. Maintenance-of-way department Pacific Electric Rys. uses such cars and motor velocipedes in maintaining signals and tracks.

SINGLE-PHASE LOCOMOTIVES. New Single-Phase Locomotives for the Swiss Bundesbahn, Hugo Studer. Elec. Ry. Jl., vol. 52, no. 10, Sept. 7, 1918, pp. 411-413, 8 figs. Description of four sample locomotives ordered for the Swiss Bundesbahn and several types developed by the Oerlikon Co. in connection with this electrification.

TRACK-CIRCUIT DESIGN. A Graphical Method of Solving D. C. Track-Circuit Problems, H. M. Proud. Ry. Engr., vol. 39, no. 463, Aug. 1918, pp. 157-159, 5 figs. Use of graphs showing total track conductance against volts on rails in finding volts on relay and trin shunt. (Continuation of serial.)

TRACK WORK. Special Track Work for Street Railways, J. V. Hunter. Am. Mach., vol. 49, no. 8, Aug. 22, 1918, pp. 335-338, 8 figs. Engineering work in connection with switches, frogs and crossovers.

RAILROAD ENGINEERING, STEAM

BOLSTERS, TRUCK. Design of Cast Steel Truck Bolsters, J. E. Endsley. Ry. Rev., vol. 63, no. 5, Aug. 3, 1918, pp. 152-154, 3 figs. States results in a bolster mast with no holes in side walls and subsequent results after holes were cut.

BRAKES. A Mechanical Brake Control System for Railways. Engineer, vol. 126, no. 3264, July 19, 1918, pp. 58-59, 7 figs. Description of details of "Rehostep" railway brake control system.

Air Brake Association in Fuel Saving. Railroad Herald, vol. 22, no. 9, Aug. 1918, pp. 195-196. Recommendations tending to decrease leakage of brake pipes on freight trains in order to save 6,000,000 tons of coal annually. Report of Committee.

Road Tests of the A. S. A. Brake. Ry. Mech. Eng., vol. 92, no. 8, Aug. 1918, pp. 453-456, 4 figs. 100-car train run on Virginian with A. S. A. and Westinghouse brakes.

Tests of the Automatic Straight Air Brake on the Virginian Railway. Ry. & Loco. Eng., vol. 31, no. 8, Aug. 1918, pp. 244-247, 6 figs. Resumé of equipment, data and chronograph records of five positions of brake balve and of speed and stop distances.

CARS. Cars for Special and Excursion Traffic, Victorian Railways. Ry. Engr., vol. 39, no. 463, Aug. 1918, pp. 160-161, 3 figs. Arrangement details of a pattern car, weighing 26 tons, with capacity for 82 passengers, recently completed at the Government railway shops at Newport, England.

High Capacity Cars on a Narrow Gauge Railway in India, Frederick C. Coleman. Ry. Age, vol. 65, no. 6, Aug. 9, 1918, pp. 265-266, 3 figs. Description of freight car of the Sheffield & Twinberrow type for the Kalka-Simla Ry.

CROSSINGS. Concrete Slab Railroad Crossings. Eng. & Cement World, vol. 13, no. 3, Aug. 1, 1918, p. 54. How they were placed at Cedar Rapids, Ia.

FREIGHT HOUSE. Pennsylvania Completes Freight House at Chicago. Ry. Age, vol. 65, no. 5, Aug. 2, 1918, pp. 215-219, 8 figs. Description of new structure of two-level type.

HOT BOXES. The Hot Box Problem, N. Marple. Railroad Herald, vol. 22, no. 9, Aug. 1918, pp. 196-198. Causes originating the hot box and suggestion to prevent them by making car owner responsible. Paper before Niagara Frontier Car Men's Assn.

HUMP YARD. 15,000-Car Hump Yard Near Chicago Planned by Illinois Central Railroad. Eng. News-Rec., vol. 81, no. 7, Aug. 15, 1918, pp. 313-316, 1 fig. Terminal for main-line trains, from which transfer trains will serve local yards, will have power-operated switches, motor-car service for car riders and L. C. L. transfer facilities for 450 cars daily.

LOCOMOTIVE BOILERS. Design and Maintenance of Locomotive Boilers. Boiler Maker, vol. 18, no. 8, Aug. 1918, pp. 231-232. Application of autogenous welding to construction and renewal of smokeboxes, flues, staybolts, fireboxes and mud rigs. Report of Committee on Design and Maintenance of Locomotive Boilers, before joint meeting of Master Car Builders and Master Mechanics Assns. Also published in Ry. Jl., vol. 24, no. 8, Aug. 1918, pp. 21-23.

Reducing Maintenance Costs on Locomotive Boilers, W. R. Toppan. Railroad Herald, vol. 22, no. 9, Aug. 1918, p. iv-A. How a terminal system cut down its flue and staybolt work following installation of a water-softening plant.

The Arrangement of Tubes in Locomotive Boilers, H. C. Webster. Mech. World, vol. 64, no. 1646, July 19, 1918, p. 33, 4 figs. Study of the arrangement necessary to secure maximum efficiency.

LOCOMOTIVE ENGINES. Modern Locomotive Engine Design and Construction. Ry. Engr., vol. 39, no. 463, Aug. 1918, pp. 151-156, 8 figs. Locomotive feed-water heating system; superheated steam and methods of superheating. (Continuation of a serial.)

LOCOMOTIVE EXHAUST NOZZLES. Locomotive Exhaust Nozzles. Ry. & Loco. Eng., vol. 31, no. 8, Aug. 1918, pp. 251-253, 2 figs. Study of part played by form of aperture in results obtained, based on physical character of phenomenon.

LOCOMOTIVES. A Three-Cylinder Locomotive. Engineer, vol. 126, no. 3625, July 26, 1918, pp. 70-72, 10 figs. Illustrations and drawings, and special reference to the Gresley valve gear. Locomotive in operation on the Great Northern Ry., England.

New 3-cylinder Locomotive, Great Northern Railway, C. S. Lake. Model Engr., vol. 39, no. 897, July 4, 1918, pp. 1-5, 6 figs. Features of locomotive recently built at the Doncaster Works, England.

Compound Mallet for the N. & W. Ry. & Loco. Eng., vol. 31, no. 8, Aug. 1918, p. 263, 1 fig. Dimensions of 2-8-8-2 type.

N. & W. 267-ton Mallet Locomotive, H. W. Reynolds. Ry. Mech. Eng., vol. 92, no. 8, Aug. 1918, pp. 445-450, 10 figs. Data, drawings and description of locomotive and its tender.

New Pacific and Mikado Type Locomotives for the Chicago, Burlington and Quincy Railroad. Ry. & Loco. Eng., vol. 31, no. 8, Aug. 1918, pp. 248-249, 2 figs. Dimensions of 4-6-2 and 2-8-2 types.

New 2-8-0 Type Locomotives for the Victorian Railways. Ry. Gaz., vol. 29, no. 2, July 12, 1918, pp. 51-52, 1 figs. Diagrams and dimensions.

First U. S. Standard Locomotive. Ry. Mech. Eng., vol. 92, no. 8, Aug. 1918, pp. 436-438, 5 figs. Description with drawings of the light Mikado type built by the Baldwin Locomotive Works.

The First of the U. S. Railroad Administration Locomotives. Railroad Herald, vol. 22, no. 9, Aug. 1918, pp. 194-195. General features of Mikado (2-8-2) type recently completed by the Baldwin Locomotive Works.

Baldwin Locomotive Works Completes the First of the U. S. Standard Locomotives. Mikado type, 2-8-2, Assigned to the Baltimore and Ohio Ry. & Loco. Eng., vol. 31, no. 8, Aug. 1918, pp. 239-240, 1 fig. Description and dimensions.

Small Locomotives of Special Types. Engineer, vol. 126, no. 3267, Aug. 9, 1918, pp. 111-112, 2 figs. Descriptions with dimensions and data of gasoline-driven locomotives of 20 and 40 hp., used at present for trench railways, but applicable for industrial railways of various types.

The Influence of Type on Locomotive Performance. Ry. Gaz., vol. 29, no. 4, July 26, 1918, pp. 108-112, 6 figs. Criticism of design for an engine of the 4-4-0 type proposed in April 12 issue, and table of comparative particulars of express locomotives of this type.

MEXICAN RAILWAYS. Serious Condition of the Railways in Mexico. Ry. Age, vol. 65, no. 7, Aug. 16, 1918, pp. 307-309. Report by Latin-American Division of Bureau of Foreign and Domestic Commerce.

RAIL FAILURES. Derailment from Rail Failures Due to Transverse Fissures. Railroad Herald, vol. 22, no. 9, Aug. 1918, pp. 190-192, 4 figs. Diagrams, microphotos, and results of physical and chemical analyses of fractured rails. Report of Chief of Bureau of Safety, I.C.C., covering investigation of an accident which occurred on the Central of Ga.

RAIL RENEWING. Labor Saving Appliances in Rail Renewing on the C. B. & Q. R. R. Ry. Rev., vol. 63, no. 7, Aug. 17, 1918, pp. 229-233, 4 figs. Rail-laying machine, rail-drilling machine, tie-sawing machine.

REPAIR SHOP. A Western Railroad Repair Shop, Frank A. Stanley. Am. Mach., vol. 49, no. 6, Aug. 8, 1918, pp. 249-252, 15 figs. Describing some methods and tools used.

Running Repairs of Locomotive Boilers and Approved Methods of Washout of Boilers. Ry. & Loco. Eng., vol. 31, no. 8, Aug. 1918, pp. 241-243, 6 figs. Data of mileage between washouts made by passenger and freight locomotives; cost of washing; methods and tools used.

Locomotive Repair Developments in Great Britain. Railroad Herald, vol. 22, no. 9, Aug. 1918, pp. 183-184. Construction details of Great Eastern Railway recently built. Special shop capable of carrying out repair on between 100-5 engines simultaneously.

Signaling. Electro-Pneumatic Interlocking Plant. H. A. Wallace. Ry. Signal Engr., vol. 11, no. 8, Aug. 1918, pp. 250-253. Details and operation of switches and signals, air valve, electro-pneumatic machine, "SS" system of signal control. Abstract of paper before Tex. Regional Committee of Ry. Signal Assn.

New Mechanical Plant on Chicago and Alton. Ry. Signal Engr., vol. 11, no. 8, Aug. 1918, pp. 239-243, 3 figs. Interlocker on a double-track main line crossing single track road, designed not to require night leverman.

Track. Interesting Reconstruction Work on the Erie. Ry. Age, vol. 65, no. 6, Aug. 9, 1918, pp. 248-252, 9 figs. Work on a 35-mile section of double track line in Indiana including some heavy grade revision.

Labor-Saving Devices for Track Maintenance. Ry. Rev., vol. 63, no. 5, Aug. 3, 1918, pp. 172-176. From a paper by L. Stimson before New England Railroad Club, May 1918.

Trans-Australian Railway. The Trans-Australian Railway. Engineer, vol. 126, no. 3264, July 19, 1918, pp. 56-57, 1 map. Difficulties of construction, description of the route, progress of construction, special problems encountered; the country traversed.

Turntables. Construction, Care and Maintenance of Turntables. Ry. & Loco. Eng., vol. 31, no. 8, Aug. 1918, pp. 250-251, 2 figs. Features of improved types.

REFRACTORIES

Testing and Inspection of Refractory Brick. C. E. Nesbitt and M. L. Bell. Blast Furnace & Steel Plant, vol. 6, no. 8, Aug. 1918, pp. 341-344, 8 figs. Results of tests on spalling (resistance to sudden thermal change), crushing and slag penetration; conclusion drawn from differences in the figures obtained. Paper before Am. Soc. Testing Materials.

REFRIGERATION

Ammonia-Absorption Machines. Gas Formation in Ammonia Absorption Refrigerating Machines. Its causes and Remedy. E. C. McKelvy and A. Isaacs. Am. Soc. Refrig. Engrs. Jl., vol. 4, no. 5, March 1918, pp. 447-463, 1 fig. Report of experimental work undertaken by special committee to investigate nature and sources of gases by means of an experimental bomb consisting of a piece of 4-in. steel pipe closed at both ends by clamped blind flanges with a female recess. Read before Am. Soc. Refrig. Engrs.

Ammonia Conservation. Conservation of Ammonia and Coal. E. N. Fiedmann and Van R. H. Greene. Ice & Refrig., vol. 54, no. 5, May 1918, pp. 268-269. Stuffing box and decomposition losses; temperature of cooling water and condenser pressure; saving coal; undesirable coal mixtures; increased evaporation. Paper before Long Island Ice Manufacturers' Assn.

Ammonia Leakage. Cost of Ammonia Leakage. Reactions, vol. 11, no. 2. Second Quarter 1918, pp. 31-36. Possibility of considerable loss of ammonia through apparently inconsiderable leaks.

Brine-Cooling System. The Practical Side of the Low Temperature Compression System. H. Solan. Am. Soc. Refrig. Engrs. Jl., vol. 4, no. 6, May 1918, pp. 549-556, 4 figs. Description of three installations operated with brine-cooling systems.

CO_2 Machines. Carbonic Acid Refrigerating Machines. J. C. Goosmann. Ice & Refrig., vol. 54, no. 5, May 1918, pp. 272-274, 3 figs. Some conditions that have delayed general adoption of carbon-dioxide refrigerating machines; practical equality of free refrigerants; actual equality of horsepower required.

Cold Accumulators. Cold Accumulators and Their Application to the Refrigerating Industry. Am. Soc. Refrig. Engrs. Jl., vol. 4, no. 6, May 1918, pp. 541-548, 2 figs. Types of tanks and formulæ for calculations. Read before Milwaukee Section of A.S.R.E.

Hospital Refrigerating Plant. Service for the Sick. Power Plant Eng., vol. 22, no. 15, Aug. 1, 1918, pp. 605-610, 6 figs. Description of power plant at Blodgett Memorial Hospital, Grand Rapids, Mich.; extensive refrigeration system.

Ice Making. Modern Stationary Can Raw Water Ice Plant. Ice & Refrigeration, vol. 55, no. 3, Sept. 1, 1918, pp. 75-84, 13 figs. Details of plans and complete equipment of plant ; arrangement of engine, freezing and ice storage rooms; method of operation and details of cost; electrical equipment and cost of power.

Preventing Red Core. Louis Block. Ice & Refrig., vol. 54, no. 5, May 1918, pp. 270-271, 1 fig. Results of a discussion at a meeting of Refrig. Engrs.

Refrigeration and Ice Making. Charles L. Hubbard. Indus. Management, vol. 56, no. 2, Aug. 1918, pp. 105-109, 14 figs. Examples of apparatus and machinery used in military camps and on shipboard.

Treatment of Water for Raw Water Ice Making. M. F. Newman. Am. Soc. Refrig. Engrs. Jl., vol. 4, no. 6, May 1918, pp. 527-540. Account of different processes. Presented before the A.S.R.E.

Ice Structure. The Crystal Structure of Ice, A. St. John, Proc. of the Nat. Academy of Sciences, vol. 4, no. 7, July 15, 1918, pp. 193-197. Photographic spectrum investigation by means of a Coolidge tube with tungsten target excited by an induction coil with mercury turbine interrupter.

Insulating Materials. Report Upon Tests of Heat Insulating Materials for Cold Storage Rooms, W. M. Thornton. Cold Storage, vol. 21, no. 244, July 18, 1918, pp. 177-178. Method of testing; relative efficiency from total ice melted; quantity of heat transmitted.

Liquefaction of Gases. Argon, Lighting and Industries Employing Very Low Temperatures (L'argon, l'éclairage et l'industrie des basses températures), Georges Claude. Mémoires et Compte Rendu des Travaux de la Société des Ingénieurs Civils de France, year 71, nos. 1-3, Jan-Mar. 1918, pp. 66-72, 2 figs. Process of liquefaction of gases and description of apparatus for obtaining a liquid mixture of 75 to 80 per cent argon and the rest oxygen; argon a nitrogen in electric lamps.

Loss in Ammonia Manufacture. Sources of Loss During the Manufacture of Concentrated Ammonia Liquor, A. Marsden. Jl. Soc. Chem. Industry, vol. 37, no. 14, July 31, 1918, pp. 230 T-232 T. Suggestions to remedy sources of losses when making ammonia.

Salt Solutions. The Freezing Points of Concentrated Solutions and the Free Energy of Solution of Salts, W. H. Rodebush. Jl. Am. Chem. Soc., vol. 40, no. 8, Aug. 1918, pp. 1204-1213. Experimental determination of freezing-point concentration curves for the components of solutions, thermodynamic equations for the force energy of solution and examples of their application.

RESEARCH

Factory Chemical Laboratory. Relation of the Chemical Laboratory to the Factory, M. B. Karr, Can. Mfr., vol. 38, no. 9, Sept. 1918, pp. 31-33, 3 figs. Before Montreal Metallurgical Assn.

Factory Research Laboratory. Planning a Research Laboratory for an Industry, C. E. K. Mees. Jl. Soc. Chem. Industry, pp. 201T-202T. Two possible forms of organization, "departmental" system and "cell" system. Abstract of paper before New York Section of Soc. Chem. Industry.

National Physical Laboratory. The National Physical Laboratory in 1917-18. Engineering, vol. 106, no. 2743, July 26, 1918, pp. 94-96. From the annual report, dealing with work of the various departments.

ROADS AND PAVEMENTS

Asphalt Roads. Asphalt Pavements, Chas. A. Mullen. Better Roads & Streets, vol. 8, no. 6, June 1918, pp. 225-229 and 252-253, 5 figs. Paper before Fifth Can. Good Roads Congress.

Procedure in the Construction and Maintenance of Kentucky Rock Asphalt Roads, S. O. Le Sueur. Mun. & County Eng., vol. 55, no. 2, Aug. 1918, pp. 49-50 Characteristics and behavior of these roads; recommended specifications.

Concrete Roads. Build Permanent Pavements at New Aeronautical Station, Samuel H. Lea. Eng. News-Rec., vol. 81, no. 10, Sept. 5, 1918, pp. 447-449, 6 figs. Town-site roadways of concrete have sub-bace throughtout at langley Field Station; special templet used for warped crown.

Concrete Road Construction During Freezing Temperatures. Eng. & Contracting, vol. 50, no. 6, Aug. 7, 1918, pp. 147-148. Sand, water and sub-grade heated before mixing and laying concrete; concrete protected by a covering of canvas and hay.

Concrete Roads in New Zealand. Surveyor, vol. 54, no. 1383, July 19, 1918, p. 30. Methods of construction in Auckland City.

How to Get the Best surface on a Concrete Road, A. H. Hunter. Mun. & County Eng., vol. 55, no. 2, Aug. 1918, pp. 47-49. Remarks on the construction of templets, building of joints, finishing surfaces and use of the roller and belt.

Cost Keeping. Cost Keeping System for County Highway Work. Contract Rec., vol. 32, no. 34, Aug. 21, 1918, pp. 657-659. Elements applying to all cases. From paper before Wash. Assn. of County Engrs. Also published in Eng. & Contracting, vol. 50, no. 6, Aug. 7, 1918, pp.145-147.

Earth Roads. Method of Building Earth Roads in Kane County, Illinois, George N. Lamb. Eng. & Contracting, vol. 50, no. 6, Aug. 7, 1918, pp. 140-141, 4 figs. Laying out curves; standard cross-sections for grading; the operations; costs of earth-road grading.

The Necessity of Engineering Supervision in Construction and Maintenance of Earth Roads, H. Ross Mackenzie. Eng. & Contracting, vol. 50, no. 6, Aug. 7, 1918, pp. 155-157. From paper before Regina Branch of Can. Soc. of Civ. Engrs.

Easement Curves. Easing and Super-Elevating the Highway Curve. Contract Rec., vol. 32, no. 32, Aug. 7, 1918, pp. 617-618. Table and diagram of super-elevations and offset for easement curves, used by the highway engineers of King County, Wash., in construction of paved roads.

Frost Action. Impervious Bituminous Wall Suggested to Prevent Seepage Under Paving. Eng. News-Rec., vol. 81, no. 5, Aug. 1, 1918, pp. 226-228, 3 figs. Extensive study made of vertical movements of pavements with reference to frost action; distribution of moisture in clay and loam sub-grades and effect of walling off shown by charts.

Gravel Roads. Iowa Methods of Constructing Gravel Roads. Eng. & Contracting, vol. 50, no. 10, Sept. 4, 1918, pp. 247-248. From bulletin issued by Iowa Highway Commission.

Highways. Highway Carries Twelve Times as Much Local Freight as Railroad. Eng. News-Rec., vol. 81, no. 5, Aug. 1, 1918, pp. 224-226. Shipments by Baltimore road increasse 480 per cent in year, saving railroads 39,923 ton-miles.

Notes on Highway Design, J. L. Harrison. Eng. & Contracting, vol. 50, no. 10, Sept. 4, 1918, pp. 237-238. Preliminary investigations; population benefited; volume of traffic; grades; distance; curvature.

Macadam Pavements. Method and Cost of Reducing Excessive Crown on a Macadam Pavement, E. Earl Glass. Eng. & Contracting, vol. 50, no. 6, Aug. 7, 1918, pp. 144-145, 2 figs. Filling in sides of the road to reduce crown described.

Military Roads. Roads in Base Section of American Forces Require Widening and Resurfacing, Robert K. Tomlin, Jr. Eng. News-Rec., vol. 81, no. 8, Aug. 22, 1918, pp. 348-352, 8 figs. Heavy traffic by motor trucks and artillery on practice marches necessitates continuous maintenance.

Road Construction. Asphalt Resurfacing in Los Angeles, C. W. Geiger. Mun. Jl., vol. 45, no. 7, Aug. 17, 1918, pp. 123-125, 6 figs. Mixture for wearing surfaces and binder furnished by municipal asphalt plant. Surface heating method employed. All done by day labor.

Handling Materials on a Michigan Road Job. Municipal Jl., vol. 45, no. 10, Sept. 7, 1918, pp. 181-182, 6 figs. Gravel for concrete dredged from neighboring lake. transported, measured and mixed.

The "National" Pavement in New Haven. Mun. Jl., vol. 45, no. 8, Aug. 24, 1918, pp. 143-145. Methods used in resurfacing old macadam and brick pavements with a cover composed of about 18 per cent asphalt and 82 per cent pulverized earthy matter, 50 per cent of which passes through a 200-mesh sieve, and nothing being retained on a 10-mesh screen.

Road-Construction Machinery. The Use of Modern Machinery in County Road Construction, C. B. Scott. Good Roads, vol. 16, no. 9, Aug. 31, 1918, pp. 80 and 88. Various modern machines and devices, and new ways in which they are being used. Paper before North Carolina Good Roads Assn.

Sand-Clay Roads. Maintaining Sand-Clay Roads in North Carolina. Mun. & County Eng., vol. 55, no. 2, Aug. 1918, p. 49. Account of investigation regarding failure of roads.

Tar Surfaces. English and American Practice in the Construction of Tar Surfaces and Pavements, A. H. Blanchard. Better Roads & Streets, vol. 8, no. 6,' June 1918, pp. 230-234 and 253, 11 figs. Paper before Fifth Can. Good Roads Congress. Also published in Eng. & Contracting, vol. 50, no. 6, Aug. 7, 1918, pp. 142 144.

War Conditions. Policy of U. S. Highways Council Regarding Highway and Street Work During the War. Eng. & Contracting, vol. 50, no. 10, Sept. 4, 1918, pp. 252. Text of regulations effective Sept. 10, 1918.

Road Building in Michigan Under War Conditions, Frank F. Rogers. Good Roads, vol. 16, no. 10, Sept. 7, 1918, pp. 89-90 and 92. Paper before Mich. State Good Roads Assn.

Water, Action of. The Action of Water on the Road Subgrade and Its Relation to Road Drainage, J. L. Harrison. Mun. & County Eng., vol. 55, no. 2, Aug. 1918, pp. 50-52. Limitations of tile drainage, capillary attraction, heavy clay soils; freezing of dry subgrades; cracking; use of Telford base; carrying capacity of subgrade.

SAFETY ENGINEERING

Acetylene. Report of the Department Committee on Cylinders for Dissolved Acetylene. Acetylene & Welding Jl., vol. 16, no. 177, June 1918, pp. 98-99. Results of experiments carried out at the Home Office Experimental Station, Eskmeals, Cumberland, with the object of ascertaining the result of igniting the acetylene in a pocket space formed in the porous material inside a cylinder, and the danger, if any, of such ighition. (Continuation of serial.)

Brick Making. Safety in Brick Making. Am. Industries (Accident Prevention Supp.), vol. 19, no. 1, Aug. 1918, 4 pp., 7 figs. Sketches of machines enclosed in standard guards.

Fires. Lessons from a Disastrous Carhouse Fire. Elec. Ry. Jl., vol. 52, no. 6. Aug. 10, 1918, pp. 239-241, 3 figs. Results of a fire caused by explosion of oil tank of a 44,000-volt lightning arrester.

Mine Rescue Stations. The Equipment and Organization of Mine Rescue Stations. A. J. Moorshead. Safety Eng., vol. 36, no. 1, July 1918, pp. 23-27. Prevention of accidents; necessary equipment and its care; first-aid supplies; exploring teams.

Scaffolding Construction. Safety in Scaffolding Construction. Building News, vol. 115, no. 3315, July 17, 1918, pp. 34-35. Reproduction of rules and regulations promulgated by the Department of Labor and Industry of the Pennsylvania Industrial Board.

Wood Alcohol. Wood Alcohol in War Time, Winefred Hathaway. Survey, vol. 40, no. 22, Aug. 31, 1918, pp. 609-611. Discusses unsuspected danger faced by thousands of workers in munition plants and elsewhere.

SANITARY ENGINEERING

Air Checking of Sewer Pipe. Reducing Air Checking in Cooling Sewer Pipe, B. T. Sweely. Brick & Clay Rec., vol. 53, no. 4, Aug. 13, 1918, pp. 291-292. Peocedure claimed to have reduced air checking 60 per cent. in middle-west plant.

Alum in Filters. The Selection of Alum for Filter Plants. Fire & Water Eng., vol. 64, no. 7, Aug. 14, 1918, p. 116. Extract of suggestions in annual report of Ontario Provincial Board of Health.

Sewage Disposal. Auto-Eductor Solves Sewage Tank Difficulty. Mun. Jl., vol. 45, no. 8, Aug. 24, 1918, pp. 145-146. Removal of large amount of greasy scum and sludge from septic tank that had resisted other pumping appliances.

Comparative Value of Activated Sludge and Sprinkling Filters, T. Chalkley Hatton. Contract Rec., vol. 32, no. 33, Aug. 14, 1918, pp. 638-641. Variation in standard effluent; area required for plants; loss of head and effect of temperature; clarification; odors; flies; disposal of sludge; cost of plants.

Design and Construction of the New Sewage Treatment Plant at Sedalia, Mo., R. E. McDonnell. Mun. & County Eng., vol. 55, no. 2, Aug. 1918, pp. 71-73. Intercepting and grit chamber; Imhoff settling'tanks; sludge-drying beds; springling filters.

Design and Construction of Water and Sewerage Works at the Hog Island shipyard, W. H. Blood. Mun. & County Eng., vol. 55, no. 2, Aug. 1918, pp. 54-57. Difficulties met; purification plant; distribution system; hydrants; sewage pumping and treatment.

Design Details of Proposed Works for the Colection and Disposal of Sewage and Pottstown, Pa., C. E. Collins. Mun. & County Eng., vol. 55, no. 2, Aug. 1918, pp. 61-64. Pumping station; settling tanks; dosing tank; filter; sludge-drying beds; capacity, operation and care.

Miles Acid Process May Require Aeration of Effluent, F. W. Mohlman. Eng. News-Rec., vol. 81, no. 5, Aug. 1, 1918, pp. 235-236, 1 fig. Experiments show that sulphur dioxide in effluent deoxygenates several volumes of diluting water.

Noval Sewerage System and Sewage Plant at Mt. Horeb, Wis., W. G. Kirchoffer. Mun. & County Eng., vol. 55, no. 2, Aug. 1918, p. 61. Description of system made entirely of concrete.

Sewage Disposal, Edward Wilcox. Surveyor, vol. 54, no. 1386, Aug. 9, 1918, pp. 66-67. Presidential address, Assn. of Mgrs. of Sewage Disposal Works. (Concluded.)

Sewering an Army Cantonment. Mun. Jl., vol. 45, no. 8, Aug. 24, 1918, pp. 141-142. Construction work at Camp Bowie, Tex., done by the Gen. Construction Co., at a cost of $80,000.

Sprinkling Filter System and Auxiliaries Versus the Activated Sludge Process, T. Chalkley. Mun. & County Eng., vol. 55, no. 2, Aug. 1918, pp. 67-70. Comparison as to standard effluent, area, loss of head, temperature, clarification, odors and cost.

The Deoxygenating Effect of the Effluent from the Miles Acid Process of Sewage Treatment, F. W. Mohlman. Eng. & Contracting, vol. 50,no. 7, Aug. 14, 1918, pp. 166-167, 1 fig. Concludes that the Miles acid effluent contains unoxidized sulphur dioxide which is oxidized at the expense of the dissolved oxygen in the water in which the effluent is diluted and that it may be oxidized before dilution by aeration for a short time with relatively small quantities of air.

Water Purification Plant. Design and Construction of the New Water Purification Plant and Pumpling Station at Checotah, Okla., V. V. Long. Mun. & County Eng., vol. 55, no. 2, Aug. 1918, pp. 70-71.

Mechanical Rapid Sand Filtration Plant for Dorval, P.Q. Contract Rec., vol. 32, no. 32, Aug. 7, 1918, pp. 615-617, 1 fig. Details of construction.

STANDARDS AND STANDARDIZATION

Inductance. Standard of Mutual Induction (Etalon d'induction mutuelle), M. A. Guillet. Jl. de Physique, vol. 7, Mar., Apr. 1918, pp. 75-87, 1 fig. Formula determining standard; theory and operation of apparatus. Presented before French Phys. Soc. (Continuation of serial.)

Screw Standards. Gaging Screws. H. J. Bingham Powell, Am. Mach., vol. 48, no. 25, June 20, 1918, pp. 1045-1046. Attempt to show way to correlate the numerous existing standards and to secure their interchangeability.

STEAM ENGINEERING

Boiler Code. Table of Allowances. F. R. Burlingame. Boiler Maker, vol. 18, no. 8, Aug. 1918, pp. 218-219, 1 fig. Figured from formulæ given in the revision of the A.S.M.E. Boiler Code published in January.

Corrosion. Surface Defects of Condenser Tubes Causing Corrosion. W. R. Webster. Page's Eng. Weekly, vol. 33, 724, July 26, 1918, p. 42. Abstract of paper before Am. Soc. for Testing Materials.

What Is the Cure for Condenser Tube Corrosion? Hartley LeH. Smith. Elec. Ry. Jl., vol. 52, no. 7, Aug. 17, 1918, pp. 283-285. Writer believes longer life will be secures from condenser tubes by proper selection of materials and care in manufacture, rather than by modification of conditions directly under control of operator.

Water Softening to Correct Boiler Corrosion. William Henry Hobbs. Ry. Rev., vol. 63, no. 5, Aug. 3, 1918, pp. 167-170. Prevention of incrustation pitting and corrosion; reference to experiments to determine the relative corrosibility of various salts and manner in which these tendencies can be corrected.

Engine Economy. Improving Engine Ecomony. M. A. Saller. Power Plant Eng., vol. 22, no. 15, Aug. 1, 1918, pp. 617-620, 6 figs. Increasing capacity and efficiency of steam engines by proper valve setting, eliminating leakage and maintaining speed regulation.

Exhaust Steam. Utilization of Exhaust Steam for Generating Electrical Energy in Collieries. (Considérations sur l'utilisation des vapeurs d'échappement dans les houillères en vue de la production d'énergie électrique). A. Barjou. L'Industrie Electrique. Year 27, no. 627, Aug. 10, 1918, pp. 287-293, 7 figs. Utilization of exhaust steam; turbo-generator groups; types of turbines. (Continuation of serial.)

Lubrication, Engine Cylinder. Problems of Steam Cylinder Lubrication. W. F. Osborne. Blast Furnace & Steel Plant, vol. 6, nos. 8 and 9, Aug. and Sept. 1918, pp. 338-341 and p. 389. Importance and difficulties of lubrication; features influencing method of lubricating, such as the cylinder, the valves, steam flow and steam exhaustion.

Pipe Lines. Relation Between Loss of Pressure and Pipe Size in Long Steam Lines. H. Eisert. Jl. Engrs. Club of Baltimore, vol. 7, no. 6, Dec. 1918, pp. 103-122, 2 figs. Technical study based on Weisbach's formula for determining flow resistance of a fluid through a conduit of uniform cross-section.

Pumping Engines. Historical Data of Steam Pumping Engines. A. O. Doane. Fire & Water Eng., vol. 44, no. 9, Aug. 28, 1918, pp. 148-149. Comparision of various types in capacity and cost.

Two Newcomen Atmospheric Pumping Engines. Gerald T. Newbould. Colliery Guardian, vol. 116, no. 3005, Aug. 2, 1918, pp. 230-231, 3 figs. One built in 1787 and the other in 1823 are still in operation. From paper before Midland Inst. of Min., Civ. and Mech. Engrs. Also published in Iron & Coal Trades Rev., vol. 97, no. 2631, Aug. 2, 1918, pp. 118-119, 8 figs.

Steam Plants, Statistics. Notes on the Development of the Use of Steam Since 1876. Robert M. Anderson. Stevens Indicator, vol. 35, no. 2, April 1918, pp. 97-107. Corliss engines, steam turbines, electric-power systems; statistics giving increase of various prime movers and electric motors during ten-year periods.

Turbine Theory. A New Theory of the Steam Turbine. Harold Medway Martin. Engineering, vol. 106, no. 2740, July 5, 1918, pp. 1-3, 1 chart. First of a series of articles; contains a steam chart based on Callender's tables and formulæ.

Turbines. Modern Steam Turbines. J. Humphrey. Iron & Coal Trades Rev., vol. 97, no. 2632, Aug. 9, 1918, pp. 147-148, 1 fig. A review of recent types.

New Turbine Plant at Hull. Tramway & Ry. World, vol. 44, no. 2, July 11, 1918, pp. 11-14. 8 figs. Installation of three-phase turbo-generating plant on scheme to augment existing high and low-tension direct-current system.

Volcanic Steam Generation. Power from Volcanic Steam. Jl. Royal Soc. of Arts, vol. 66, no. 3429, Aug. 9, 1918, p. 602. Brief notes on Southwestern Tuscany plant where electric energy is obtained from low-pressure alternating turbines operated with volcanic steam.

STEEL AND IRON

Blast-Furnace Operation. Blast-Furnace Bears. J. E. Stead. Proc. British Iron & Steel Inst., May 2-3, 1918, Paper no. 9, 42 pp., 5 figs. Discussion of variable character of bear (mass of metal found below the hearth level of a blast furnace after it has been blown out); evidence of the existence of kish, sulphides of manganese and iron. cyano-nitrite of iron, titanium di-cyanide, oxides, silicates, phosphides and carbide crystals, and unique specimens, in the composition of some bears; hypotheses explaining their genesis.

Conservation of Manganese in Steel Production. A. N. Diehl. Blast Furnace & Steel Plant, vol. 6, no. 9, Sept. 1918, pp. [illegible]. Discussion read before Am. Iron & Steel Inst.

Copper Tuyeres for Blast-Furnaces. A. K. Reese. Proc. British Iron & Steel Inst., May 2-3, 1918, Paper no. 6, 6 pp., 2 figs. Details of design and adaptation.

Fuel Economy in Blast-Furnaces. J. C. Hutcheson. Proc. British Iron & Steel Inst., May 2-3, 1918, Paper no. 5, 14 pp., 6 figs. Report of work done at the Skinningrove Iron Co.'s plant, consisting of two 8-ft. hearth and three 10-ft. hearth furnaces, and inferred observations on the importance of effectively cleaning the ironstone at the belt, the conditions that secure long life of furnace lining, and fuel economy. Also published in Blast Furnace & Steel Plant, vol. 6, no. 9, Sept. 1918, pp. 378-380, 3 figs.

Inquiry on Blast-Furnace Practice in the United Kingdom. Proc. British Iron & Steel Inst., May 2-3, Paper no. 2, 19 pp. Effect of the mechanical and chemical conditions of raw materials on furnace working; influence of dimensions of the bell relative to stock line; use of double bells, size and quality of fuel used; use of waste gas for calcining ironstone. Report of committee summarizing answers received from owners of blast furnaces.

Principal Changes in Blast-Furnace Lines. J. G. West. Blast Furnace & Steel Plant, vol. 6, no. 8, Aug. 1918, pp. 323-329, 29 figs. Bronze cooling plates inserted in brickwork; development of wider hearths; use of high blast temperatures; discussion of theoretical lines. From paper before Am. Iron & Steel Inst. (Concluded.)

Briquetting Iron Ores. Present Knowledge and Practice in Briquetting Iron Ores. Guy Barrett and T. B. Rogerson. Automotive Eng., vol. 3, no. 7, Aug. 1918, pp. 310-311, 1 fig. Methods followed and machines used in this work, with special reference to conditions in United States, England and Continental Europe. (Third of series.)

The Briquetting of Pulverable Iron Ore and Blast-Furnace Slime. (Le briquetage des minérais de fer pulvérulents et des poussières de hauts fourneaux). G. Barrett and T. B. Rogerson. Génie Civil, vol. 73, no. 4, July 27, 1918, pp. 70-73. Collection of practical data. From a report before Iron and Steel Inst. (To be continued.)

Cast Iron. The Fluidity of Molten Cast Iron. Matthew Riddell. Foundry, vol. 66, no. 313, Sept. 1918, pp. 408-411, 1 fig. From a paper before British Foundrymen's Assn.

Chemical Constitution of Steel. Iron, Carbon and Phosphorus. J. E. Stead. Proc. British Iron & Steel Inst., May 2-3, 1918, Paper no. 19, 24 pp., 23 figs. Account of experiments performed in order to investigate the effect of introducing carbon, by cementation, into homogeneous solid solutions of iron and phosphorus and temperature ranges in which free phosphide of iron passes in and out of solid solution in iron.

Non-Metallic Inclusions: Their Constitution and Occurrence in Steel. A. McCance. Proc. British Iron & Steel Inst., May 2-3, 1918, Paper no. 14, 48 pp., 36 figs. Effect in strength of stressed material; position in relation to the ingot; eithing reagents; influence of aluminum on sulphides; oxidation products of manganese sulphide; acid open-hearth slags and their reduction products; equilibrium conditions in liquid steel; results of analyses and examination of microphotographs of etchings.

Note on Inclusions in Steel and Ferrite Lines. Proc. British Iron & Steel Inst., May 2-3, 1918, Paper no. 13, 6 pp., 13 figs. Results of experiments which led the author to the conclusion that the phosphorus associated with non-metallic inclusions in steel leads to the formation of ferrite ghost lines.

Coke. The Importance of Coke Hardness. G. D. Cochrane. Proc. British Steel & Iron Inst., May 2-3, 1918, Paper no. 3, 11 pp., 3 figs. Results of experiments which led the author to establish as an axiom that the practical success of the working of a blast furnace is chiefly dependent on the mechanical condition of the coke used.

Cold-Working. The Effect of Cold-Work on the Divorce of Pearlite. J. H. Whiteley Proc. British Iron & Steel Inst., May 2-3, 1918, Paper no. 17, 9 pp., 14 figs. Investigation in the study of Eggertz color test for combined carbon consisting of experiments in which drillings of pearlitic steels were annealed in vacuo for about an hour at 650 deg. cent.; a small section of a hammered bar was heated in vacuo for periods of 15 min. at successive temperatures between 450 and 690 deg. cent., and finally a section of the hammered bar and a piece of the unstrained steel were heated together for 4 hr. at 600 deg. cent.

The Effects of Cold-Working on the Elastic Properties of Steel, J. O. Van Den Broek. Proc British Iron & Steel Inst., May 2-3, 1918, Paper no. 18, 41 pp., 15 figs. Materials and apparatus; manner of conducting tests; measurements; discussion of data; effects of cold-stretching and cold-twisting; electric resistivety of cold-worked steel; effects on alloy steels; theory; microstructure; tests on steel balls; analysis of commercial process. Published also in Engineering, vol. 106, no. 2743, July 26, 1918, pp. 99-105, 15 figs.

Damascene Steel. Damascene Steel, N. Belaiew. Proc. British Iron & Steel Ints., May 2-3, Paper no. 20, 22 pp., 5 figs. History, external characteristics and three principal processes of manufacture; Anossoff's classification of patterns of damascene blades; author's analyses; explanation for ductility, malleability and elasticity of damascene alloys.

Electric Furnace Melting. Electric Cast Iron and Steel Manufacture (La production électrothermique des fontes et aciers), Jean Escard. Revue Générale des Sciences, year 29, no. 12, June 30, 1918, pp. 666-673, 4 figs. Héroult furnace; experiments of Sault-Sainte-Marie; California New-Héroult furnaces; Trollhattan electric furnace: Keller process.

Electric Furnace Production of Cast Iron and Steel (La production électrothermique des fontes et aciers), J. Escard. Revue Générale des Sciences, year 29, no. 13, July 15, 1918, pp. 401-413, 18 figs. Comparative study of five methods of manufacturing steel.

Electric Steel Production for Small Units, A. V. Farr. Blast Furnace & Steel Plant, vol. 6, no. 9, Sept. 1918, pp. 381-383, 6 figs. Description of cold-metal method predominating in electric-furnace units under 10-ton capacity; data on 6-ton Héroult furnace making high-carbon chrome steel. Paper before Am. Drop Forge Assn.

Metallurgical Electric Furnaces. Engineering, vol. 106, no. 2743, July 26, 1918, pp. 86-87, 8 figs. Electric steel-refining furnaces; features of control. From discussion by Faraday Society at Manchester, Feb. 1918.

Electric Steel, Franklin D. Jones. Machy., vol. 24, no. 12, Aug. 1918, pp. 1104-1110, 11 figs. Advantages of electric furnace; types and methods of operation.

Electric Resistance of Steel. [illegible] Low Carbon Steel [illegible] martensitens Konstitution vid lag Kolhalt ach dess infly tande pa elektriska ledningsmotstandet), C. Denedicks and E. Walldow. Bihang till Jern-Kontorets Annaler, vol. 19, no. 6, June 15, 1918.

Eutectic Alloys. Eutectic Alloys, Clifford W. Nash. Chem. Eng. & Min. Rev., vol. 10, no. 114, March 1918, pp. 161-166, 9 figs. Study in the structure of iron-carbon eutectic and eutectoid. (Concluded.)

Ferro Alloys. Carbon-free Ferro Tungsten, A. F. Braid. Reactions, vol. 11, no. 2, Second Quarter 1918, pp. 28-29. Uses of ferrotungsten and tungsten powder.

The Manufacture of Ferro Alloys in Colorado, Robert M. Keeney. Eng. & Min. Jl., vol. 106, no. 9, Aug. 31, 1918, pp. 405-409. From paper before Colorado meeting of Am. Inst. of Min. Engrs., Sept. 1918.

Ingots. Defects in Steel Ingots, J. N. Kilby. Iron & Steel Inst. of Canada, vol. 1, no. 7, Aug. 1918, pp. 288-296, 13 figs. Previous conclusions upon influence of casting in relation to cracks in ingot or bar; composition of slags of different steel-making processes, their physical state, and relationship in utimate product; basic open-hearth steel, with some reference to electric process. Abstract of papers before Sheffield Soc. of Engrs. and Staffordshire Iron & Steel Inst., coupled with further observations and results. Published also in Proc. British Iron & Steel Inst., May 2-3, 1918, Paper no. 12, 24 pp., 13 figs.

Magnetic Properties of Steel. Correlation of the Magnetic and Mechanical Properties of Steel, Chas. W. Burrows. Sci. Papers of the Bureau of Standards, no. 272, March 29, 1916, 208 pp., 42 figs. Relation of the magnetic to the other characteristics; magnetic behavior under influence of mechanical stresses greater and smaller than elastic limit; inhomogeneities and flaws; bibliography.

Development of Magnetic Susceptibility in Manganese Steel by Prolonged Heat Treatment, Charles F. Brush. Proc. Am. Phil. Soc., vol. 57, no. 4, 1918 pp. 344-353, 3 figs. Experiments performed on 19 bars, each 6 in. long and ½ in. in diameter.

Rolling Mills. Plate Production Expedites Shipbuilding, A. M. Staehle. Blast Furnace & Steel Plant, vol. 6, no. 9, Sept. 1918, pp. 361-365, 8 figs. Rolling-mill capacities increased 20 per cent and material saved by efficient plate specifications; many new plate mills built; description of Liberty Mill of Carnegie Steel Co.

Practical Pointers on Wire Rod Rolls, W. S. Standiford. Blast Furnace & Steel Plant, vol. 6, no. 9, Sept. 1918, pp. 367-369, 3 figs. Consideration of design of passes and roll trains; draft influenced by form of pass, structure of metal and degree of heat.

Producing Special Steel to Suit Specific Purposes. Can. Machy., vol. 20, no. 2, July 11, 1918, pp. 33-34, 9 figs. New strip mill at Massillon, Ohio.

New installation for Rolling Alloy Strips. Blast Furnace & Steel Plant, vol. 6, no. 8, Aug. 1918, pp. 319-321. Departure in strip mill practice by the Nat. Pressed Steel Co., Massillon. O.

The Slick Wheel Mill. Iron Age, vol. 102, no. 9, Aug. 29, 1918, pp. 491-498, 17 figs. Commercial products formed directly from large rolled bars by rolling-forging process at Cambria Steel Works.

Scrap Steel. Discard Steel. Steel & Metal Digest, vol. 8, no. 8, Aug. 1918, p. 474. Uses and properties of shell-discard steel.

TESTING AND MEASUREMENTS

Balloon Fabrics. See Permeability, below.

Carbon Dioxide Recorder. CO_2 Recorders in the Boiler House, John B. C. Kershaw. Engineer, vol. 126, no. 3264, July 19, 1918, pp. 45-47, 10 figs. Boiler efficiencies and need for improvement; heat losses in the boiler plant and their control; seven types of automatic apparatus for recording CO_2 percentages described.

Clocks, Electric. Electrical Horology, H. R. Langman. Model Engr. & Electn., vol. 39, no. 902, Aug. 8, pp. 72-77, 6 figs. Compilation of systems of electric clocks. (To be continued.)

Dynamometers. Commercial Dynamometers (IV), P. Field Foster. Mech. World, vol. 64, no. 1647, July 26, 1918, pp. 42-43, 4 figs. The rope-brake type invented by Lord Kelvin. (Continuation of serial.)

Elastic-Limit Recorder. An Improved Elastic Limit Recorder. Automotive Industries, vol. 39, no. 7, Aug. 15, 1918, p. 287, 1 fig. Attachment to a standard testing machine by means of which it is claimed one person can accurately determine the elastic limit of specimens both in tension and compression.

New Elastic Limit Recorder, J. L. Jones and C. H. Marshall. Iron Age, vol. 12, no. 7, Aug. 95, 1918, pp. 391-392, 2 figs. Sumner instrument enables tests to be made accurately and rapidly. From paper before Am. Soc. for Testing Materials, June 1918.

Electrical Measurements. A New Method of Measuring Alternating Currents and Electric Oscillations, I. Williams. Elecn., vol. 81, no. 12, July 19, 1918, pp. 253-255, 5 figs. Abstract of paper before Phys. Soc.

Fluid Gage. Coats Precision Fluid Gage. Am. Mach., vol. 49, no. 10, Sept. 5, 1918, p. 451, 1 fig. Data and description of a precision gage operating on the fluid principle, and used as a comparator, primarily, and not an actual measuring machine. Built by the Coats Machinery Co., Philadelphia, Pa.

GAGES. Industrial Gages (Les calibres industriels), Ch. Ed. Guillaume. Revue Générale de l'Electricité, vol. 4, no. 5, Aug. 3, 1918, pp. 141-145, 1 fig. Evolution of length standards; joint action of International Bureau of Weights and Measures and Technical Section of the Artillery; temperature of definition coefficients of expansion of several metals; standards, official resolutions.

GLOVES, RUBBER. Lineman's Rubber Gloves Under Test, F. C. Perkins. Wireless Age, vol. [illegible], no. 12, Sept. 1918, pp. 1038-1041, 2 figs. Method used by the Duquesne Light Co., Pittsburg.

HARDNESS OF METALS. A Law Governing the Resistance to Penetration of Metals When Tested by Impact with a 10 mm. Steel Ball; and a New Hardness Scale in Energy Units, C. A. Edwards. Jl. Inst. Mech. Engrs., no. 5, June 1918, pp. 335-369, 9 figs. Experimental investigation from which author establishes as the law governing penetration resistance of plastic metals $d = C\,E^{0{\cdot}25}$ where d = diameter of indent made by 10 mm. ball, C is a constant varying with hardness of metal and E = total energy of impact.

Testing Hardness of Metals by the Bovelle-Morin Apparatus, C. J. Bowen Cooke. Jl. Inst. Mech. Engrs., no. 5, June 1918, pp. 331-333, 4 figs. Outfit and method of making a test.

LUBRICANTS, TESTING. Methods of Conducting Tests of Lubricants on Internal Combustion Engines, S. F. Lentz. Lubrication, vol. 5, no. 9, July 1918, pp 4-9. Suggestions regarding extent to which local conditions should be considered in estimating importance of results obtained in tests.

The Testing of Lubricants, Raymond Francis Yates. Am. Mach., vol. 49, no. 7, Aug. 15, 1918, pp. 289-291, 3 figs. Explains various characteristics of lubricating oils and greases and how they may be tested with simple apparatus.

METERS, ELECTRIC. Demand Meters, J. A. Laubenstein. Gen. Elec. Rev., vol. 21, no. 8, Aug. 1918, pp. 573-576, 6 figs. Consideration of the actual measurement of "demand" and description of various types of meters designed for the purpose of determining the maximum demand rate of charge for power.

Effect of Daily Variations of Frequency on Reading of Induction Meters (Influence des variations journalières de la fréquence sur les indications des compteurs d'induction), M. A. Durand. Revue Générale de l'Electricité, vol. 4, no. 5, Aug. 3, 1918, pp. 136-140, 6 figs. Results of tests performed by Central Electrical Laboratory. From paper before French Society of Electricians.

Report of the Meter Committee. Elec. News, vol. 27, no. 13, July 1, 1918, pp. 45-48, 4 figs. Study of four methods for determining efficiently the power factor [illegible] standard instruments. Paper before Can. Elec. Assn.

METERS, HEAT. Heat Meters (Les compteurs calorimétriques ou compteurs de chaleur), R. Joëssel. Génie Civil, vol. 73, nos. 1 and 2, July 6, and 13, 1918, pp. 12-13 and 28-30, 3 figs. Résumé of work done to devise an instrument for measuring the amount of heat supplied for a fluid; applications and utility of this instrument. (Concluded.)

MOVING PHOTOMICROGRAPHS. How Moving Photomicrographs Are Taken. Iron Age, vol. 102, no. 6, Aug. 8, 1918, pp. 323-325, 10 figs. Apparatus for recording the gradual changes in a metal's structure when subjected to repeated bending stresses; possible applications.

PERMEABILITY. Determination of Permeability of Balloon Fabrics, J. D. Edwards. Aviation, vol. 5, no. 2, Aug. 15, 1918, pp. 103-106, 1 fig. Various methods for determining permeability to hydrogen; detailed description of method used at Bureau of Standards; discussion of phenomena of passage of gases through rubber by solution; data showing effect upon apparent permeability at different experimental conditions such as temperature, pressure, humidity of the gas, durations of test, etc.

RAILROAD TESTING LABORATORY. New Testing Laboratory, Southern Railway Alexandria, Va. Ry. Rev., vol. 63, no. 5, Aug. 3, 1918, pp. 151-152, 3 figs. Brief description of laboratory and its equipment.

REFRACTORIES, TESTING. Crushing Strength of Magnesia-Silica Mixtures at High Temperatures, O. L. Kowalke and O. A. Hougen, Iron & Steel Inst. of Canada, vol. 1, no. 7, Aug. 1918, pp. 300-304, 11 figs. Description of apparatus used: results of physical tests and microscopic examination.

RESONANCE MEASUREMENTS. Resonance Measurements in Radio-Telegraphy with the Oscillating Audion, L. W. Austin. Jl. of Wash. Academy of Sci., vol. 8, no. 14, Aug. 19, 1918, pp. 498-500. Examples illustrating the procedure with the resonance click.

SPECIFIC GRAVITY DETERMINATION. Determining Specific Gravity of Viscous Tar. etc., at different temperatures, Renford Myhill, Gas Jl., vol. 143, no. 2882, Aug. 6, 1918, p. 254. Method used by writer.

Tar. See Specific Gravity Determination

SPECIFIC HEAT. Calorimetric Determination of Curie's Point (Détermination calorimétrique du point de Curie). Jl. de Physique, vol. 7, March-April 1917, pp. 87-88. Method used by Weiss, Piccard and Carrard for measuring the mean specific heat Cm of ferromagnetic substances at temperatures between 16 deg. and 900 deg. cent.

STEAM, QUALITY OF. Testing the Quality of Steam, W. A. Taller. Mech. World, vol. 63, no. 1642, June 21, 1918, pp. 296-297, 1 fig. Effect of moisture in steam on turbine blades and on reciprocating engine cylinders, also on lubrication; outline of two methods for determining percentage of moisture, by the throttling calorimeter and by weighing; formulæ for computations.

STEEL TESTING. Tests on Tie Bar from the Menai Suspension Bridge. Engineer, vol. 126, no. 3264, July 19, 1918, pp. 47-49, 3 figs. Report of the physical and metallurgical tests and the electrical resistance test.

TANKS, MEASUREMENTS. Finding the Contents of a Horizontal Cylindrical Tank, Franz Szabo. Power, vol. 48, no. 8, Aug. 20, 1918, pp. 266-267, 1 fig. Gives alignment chart for the purpose.

Volumes of Cylindrical Tanks, M. W. Ward. Power, vol. 48, no. 5, July 30, 1918, pp. 159-160, 1 chart. Ready method of finding contents of a horizontal cylindrical tank with contents at any depth.

VACUUM DETERMINATION. Production and Measurement of High Vacua. J. E. Shrader and R. G. Sherwood. Phys. Rev., vol. 12, no. 1, July 1918, pp. 70-80, 7 figs. Attempt to modify operation of the mercury diffusion pump and the Knudsen molecular gage and tests of the two machines used in combination.

VISCOSIMETER. The Standardization of the Saybolt Universal Viscosimeter, W. H. Herschel. Jl. of Franklin Inst., vol. 186, no. 2, Aug. 1918, pp. 243-245. Equations between absolute viscosity and density obtained by using standard Saybolt instruments. From Technical Paper no. 112 of the Bureau of Standards.

THERMODYNAMICS

Some Recent Studies in Heat Transmission, A. J. Wood. Am. Soc. Refrig. Engrs., Jl., vol. 4 no. 5, March 1918, pp. 464-506, 8 figs. Work of thermal testing plant of Pennsylvania State College planned to include: Determination for various common materials of internal conduction (C) and combined coefficient (K) of convection and radiation as affected by velocity, humidity, difference of temperature and condition of surface: separation of this combined coefficient into its two factors, radiation and convection; deduction of laws which can be readily applied by heating and refrigerating engineers to building construction, including both simple and compound walls. Presented at annual meeting of Am. Soc. Refrig. Engrs.

TRANSPORTATION

MARINE TERMINALS. Marine Terminals for Inland River Cities Located on High Ground, H. McL. Harding. Int. Mar. Eng., vol. 23, no. 8, Aug. 1918, pp. 479-481, 7 figs. Principles governing construction of efficient river terminals; design and equipment; mechanical coordination between water and rail.

VARIA

Tractors Rough-Level Lands Before Sale to Settlers. Eng. News-Rec., vol. 81, no. 10, Sept. 5, 1918, pp. 438-439, 4 figs. Reclamation engineers get costs of putting acreage on as favorable conditions as units first entered upon.

COLORED PHOTOGRAPHY. Dufay Colored Photography (El procedimiento versicolor Dufay para la fotografiâ en colores). Boletin de la Sociedad de Fomento Fabril, year 35, no. 4, Apr. 1918, pp. 177-180, 6 figs. Successive operations in manufacture of films for colored photos.

COPPER STATISTICS. The Future of Copper, W. F. Staunton. Min. & Oil Bul., vol. 4, no. 9, Aug. 1918, pp. 371-373, 3 figs. Chart showing world production for 28 years and considerations of the needs of industry.

DIAMONDS. Formation of Diamonds (La formation du diamant), Ch. A. Parsons. Revue Générale des Sciences, year 29, no. 11, June 15, 1918, pp. 327-333. Survey of systematic researches of the origin of diamonds and considerations on possibility of arriving at a definite conclusion in this question.

ENGINEERING SOCIETIES. Centralized Activities of U. S. National Engineering Societies, Alfred D. Flinn. Can. Engr., vol. 35, no. 7, Aug. 15, 1918, pp. 151-154. Exposition of United States conditions to Canadian engineers.

EXPLOSIVES. Science of Quarrying Rock with Explosives. Du Pont Mag., vol. 9, no. 2, Aug. 1918, pp. 4-8, 4 figs. Different ways of making blasts; suggestions and remarks.

Tunnel-Blasting at Chuquicamata, E. E. Baker. Western Eng., vol. 9, no. 9, Sept. 1918, pp. 366-372, 5 figs. Blasting for steam-shovel work in bench about 180 ft. high.

FILTERS. Filter Adjustments at Packard Mill at Rochester, Nevada, F. Dean Bradley. Eng. & Min. Jl., vol. 106, no. 5, Aug. 3, 1918, pp. 207-209, 3 figs. A mechanical sampler and a mixer for repulping the tails were added to the filter, the number of nozzles increased and a nozzle constructed for spraying wash solutions.

MOISTURE RATIO. Moisture Ratio, A. Smith. Aerial Age, vol. 48, no. 1228, July 12, 1918, pp. 48-49. Remarks on H. A. Noyes' article on Reporting Moisture Results, Science, vol. 47, no. 1212, p. 293, and Bul. no. 107, Bureau of Chemistry, Official Methods of Analysis, compiled by the Association of Official Agricultural Chemistry.

PUBLIC UTILITIES. Cost Versus Value of Service in Rate Making, John Bauer. Elec. World, vol. 72, no. 9, Aug. 31, 1918, pp. 388-389. Discussion of fundamental purposes and factors that must be considered in general system of public utility control; changing what the traffic will bear; popularity of cost rates.

SALVAGE. The Admiralty Salvage Section. Engineering, vol. 106, no. 2740, July 5, 1918, pp. 16-17, 2 figs. Description of some of the work of this section of British Navy.

TIME ZONES. Proposed New Boundaries for Standard Time Zones, Emerson W. Judd. Ry. Age, vol. 65, no. 5, Aug. 2, 1918, pp. 209-211, 1 fig. Elaborate and ingenious plan for relieving all large cities of the double time standard.

WOOD

(*See* Timber and Wood)

EMPLOYMENT BUREAU

A Clearing House of Engineering Positions in Canada.

This department is one of the features by which it is hoped to be of greater service to the engineer and particularly the younger men. Firms and individuals requiring engineering assistance will have their inquiries listed in this department. Those out of employment or desirous of a change are invited to make use of it, without charge and in confidence.

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Basing conclusions upon the income-tax returns, the best paying profession in the United States is that of engineering. It excells even that of law, which long held the record, and is far ahead of those of theology and medicine. The reason for this is not difficult to find. This a constructive age, even though the war would seem to contradict such an assertion. After the war, when reconstruction generally sets in, the engineers bid fair to become a class of plutocrats.—*Christian Science Monitor.*

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Wanted for a new proposition a thoroughly competent mechanical engineer who has had good experience in laying out plants and installing machinery. He is required for a new proposition which would necessitate his travelling for a number of months to study it thoroughly by visiting various plants in the U.S. Salary to start $250.00 per month. Address Box 21.

Assistant Chief Engineer.

An assistant chief engineer in the Irrigation Branch of the Department of the Interior, with headquarters at Calgary, at a salary at the rate of $4,000 per annum. Candidates must have had a wide experience in the construction and operation of irrigation works. Address, before the 17th day of October, candidates from British Columbia have one week later, to Civil Service Commission of Canada, Ottawa, Wm. Foran, Secretary.

Civil Engineer for Air Service

In connection with the organization of the Royal Canadian Naval Air Service, a civil engineer will be required having the following qualifications:—

> A graduate of a recognized engineering school or university, preferably Canadian, with a minimum of two years practical field experience in actual construction work, preferably in the layout and construction of buildings. The department will give preference to candidates having seen military service, and would prefer a young man age not over thirty or thereabouts, of good personality and in sound physical condition. This officer would be given a commission in the R.C.N.A.S., as Aviation Lieutenant for the duration of the War, with the possibility of permanent service should the air Service be continued.

Address, Recruiting Officer, R.C.N.A.S., Banque Nationale Bldg., Ottawa, Ont.

Good Roads.

The Geological Survey, Ottawa, is about to publish a report that will be in demand by men interested in the good roads movement. This report will present the results of field and laboratory investigations made on materials suitable for road construction in the vicinity of Regina. The character of the various sand and gravel deposits will be described and an estimate made of the amount of material available in each. A map giving the location of the deposits will accompany the report. A copy of this publication will be mailed to applicants as soon as it is received from the press.

Effective Committee Work.

In addition to the Chairman and Secretary of the Halifax Branch the following constituted the local committees and their effective work contributed no small amount to the success of the gathering; Papers: Capt. J. L. Allen, J. W. Roland, A. J. Barnes; Entertainment: L. H. Wheaton, P. A. Freeman, R. McColl; Hotel and Transportation: W. P. Morrison, F. H. McKechnie, J. R. Freeman.

THE PROBLEM OF CITY DEVELOPMENT

AN ECONOMIC SURVEY

By A. G. Dalzell, A. M. E. I. C.—Vancouver Branch

The present paper is less a contribution to municipal engineering than a study of an economic problem by an engineer. The financial statements are taken entirely from public sources, open to everyone, whether municipal, official or private citizen. It will be found however, that the widened vision of the engineer's function which is being taken at the present time includes the making of such studies by men of engineering training and outlook. The Dominion Government is fostering such studies through the Commission of Conservation, and the provincial governments, civic authorities and universities of Canada have duties of both investigation and education in the matter. If blame attaches at all for the position in which Vancouver and many other cities find themselves, it attaches to the people as a whole rather than to the administrators who were chosen by the people. They would have been sharply criticised if they had introduced any big changes of plan before the people had been educated up to them. It is just this process of educating the people up to wide and true views which requires to be taken in hand at the present time.

The distribution of population is a world old problem, going back to the days when the servants of Abram and Lot strove with one another because "the land was not able to bear them that they might dwell together." In every age of the world, wars and revolutions no less than pestilences and plagues have resulted from the imperfect distribution of the people. Germany's demand for a "place in the sun," which has led to the present world catastrophe, involves this question of distribution, though it turns much more upon carefully implanted ideas of Germany's world dominance. The worst period of unrest in Ireland had its origin in the wrong distribution of an agricultural population, aggravated by an utterly unsuitable land system. The troubles among the working classes in its cities had their origin in housing conditions which were an extreme case of congestion.

The problem of distribution is to-day more acute than ever because of the world wide tendency to drift from rural to urban communities. Life is more complex, public health is more difficult to maintain, public administration is more subject to neglect or abuse, and public spirit is harder to foster in the modern city than it was even fifty years ago.

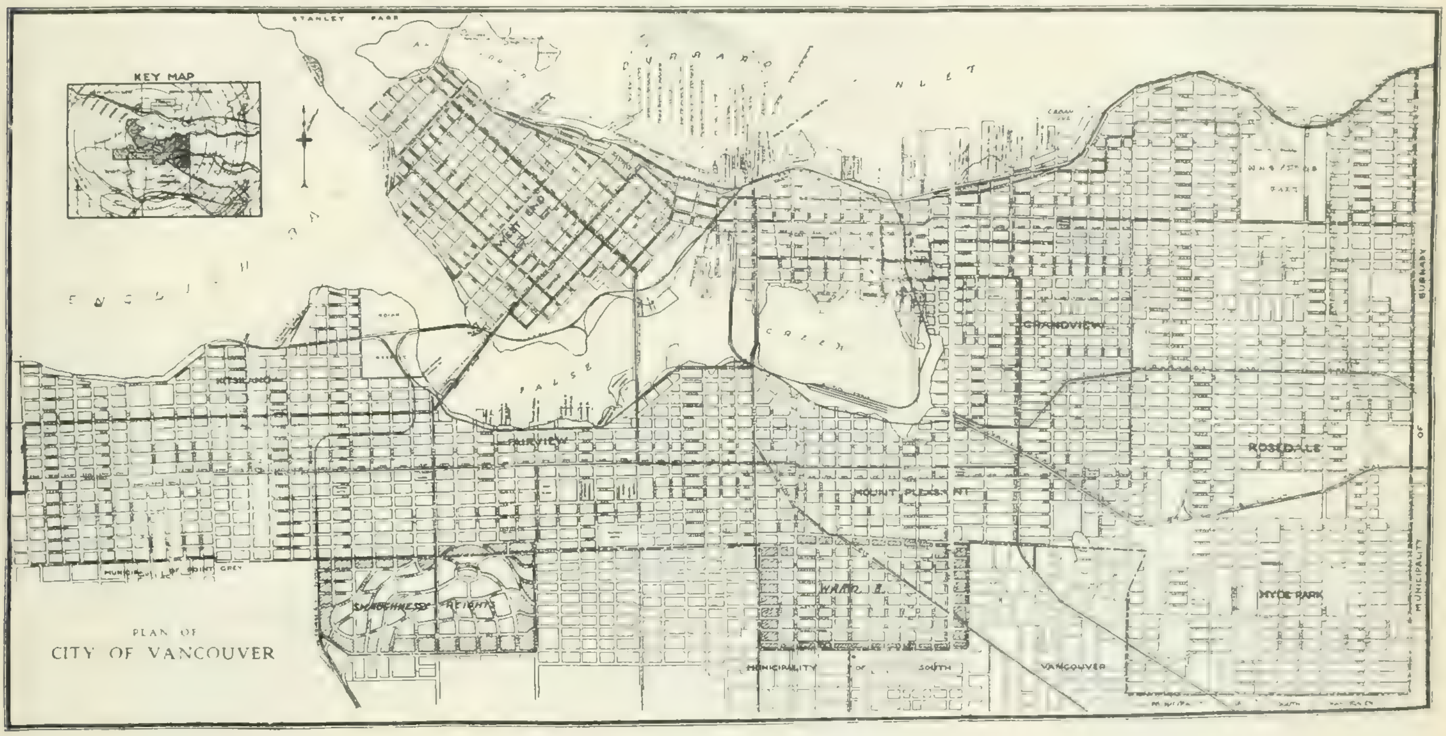

Fig. 1. Map of the city of Vancouver.

It is recognized that the proper distribution of the rural population is one of the greatest of Canadian problems; but next in importance comes the distribution of the city population. In the United States one person in every twenty lived in a city with a population of 8000 or more in the year 1820. In 1900 one person in every three did so. In the last census period, from 1900 to 1911, the urban population of Canada increased 62½ per cent, while in the same period, only 17 per cent. was added to the total rural population, though nearly two

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million immigrants were admitted. The crowded condition of European cities has long been known; but even in New York the census of 1890 showed a density of 524 persons per acre in one ward.

Even the oldest cities on the North American continent are modern as compared with those of the old world. The plans of American cities show that their development was in some sense ordered; while in Europe and Asia the development was very slow, and the plans which were evolved were scarcely ever regular. The roads followed the courses of old trails and highways, and were often narrow and winding, their makers simply taking the easiest line, and the builders of houses accommodating their frontage to the crooked thoroughfare as the districts gradually filled up.

A commission was appointed in 1807 to prepare a plan for that part of New York city which is now known as the Borough of Manhattan. One of the first tasks of its members was to settle " whether they should confine themselves to rectilinear and rectangular streets, or whether they should adopt some of those supposed improvements by circles, ovals and stars which certainly embellish a plan, whatever may be their effect as to convenience and utility." The conclusion reached by them was that " a city must necessarily be composed principally of the habitations of men, and that straight sided and right angled houses are the cheapest to build and the most convenient to live in." The effect of this decision was doubtless to give a great impetus to the adoption of the rectangular or checker board system in other American cities. Experience has however shown, that the rectangular system is not perfect, and its defects become more apparent as a city extends. American cities are to-day spending vast sums of money in constructing radial or diagonal roads to overcome some of the defects of the system.

The city of Vancouver. (Fig. I.) is laid out on the rectangular system; but it can hardly be said that it was over planned. It has grown by the addition of one subdivision to another. The only requirements looked for seem to have been that the streets should be of a standard width, and that the blocks in a subdivision should be approximately uniform and parallel. As the plan of a city is the biggest problem in determining the cost of development, it is of importance at the present time to consider some of the defects of the plan of Vancouver in the light of its own experience, and that of older cities, and to discuss the changes which would have to be made in order to remedy these defects. Delay in making these changes can only lead to greater expense when they are made at last; and it is one of the aims of the writer to show that the cost of its development on the present lines is going to be such a burden as to unduly delay the final development.

When peace is concluded, and the nations can again attend to business, a great international redistribution of population is sure to take place. The community which can offer steady employment, coupled with good housing conditions and an equitable and modern system of taxation, will attract the new population and become wealthy. Few will deny that the future prosperity of Vancouver depends upon an early increase of population. Heavy indebtedness has been incurred to provide for the anticipated increase; but money is still necessary to provide a civic centre, with a proper city hall, an art gallery, a new public library, concert hall and technical institute. These and many other things necessary for healthy community life can only be obtained without unduly heavy taxation by the help of a largely increased population.

The cardinal requirements of situation and climate are satisfied in Vancouver with a completeness which is rarely matched. Its harbour facilities and water supply are of the highest class. Given these things, it seems only reasonable to expect that both employers and employed should be able to find in it all that they can reasonably ask. With sane and judicious administration they will certainly find it. But a satisfied population will not result from adherence to the methods of development which were evolved by our grandfathers, and are not suitable to the present age. The continued adherence to such old plans of city development is one of the strangest failings of a people so ready to adopt modern methods in other things.

It is not easy to find out the exact cost of city development, or indeed of any city undertaking. The absence of a standard system of municipal accounting makes comparison of one city with another difficult, and often misleading. The writer has taken a section of the city of Vancouver which forms Ward 8, and compared it with Shaughnessy Heights, a neighbouring district of nearly equal area, which however, has been developed on a different plan. Though Shaughnessy Heights is outside the city boundary, both it and Ward 8 lie within the same radial zone, between two and three miles from the centre of the city. Ward 8 is typical of those sections of the city which are occupied by the artizan class; while Shaughnessy Heights is regarded as a high class residential district of Vancouver though it is included in the Point Grey municipality.

The scheme of subdivision adopted in Ward 8 (Fig. 2.) was prepared and registered in 1885; but there was little development for nearly a quarter of a century afterwards. No competent person would expect to build houses, steam engines, ships, or railways according to plans a quarter of a century old; but plans even older than that are still thought good enough to serve for the building up of such complex things as cities. This idea prevails so generally, that nothing but a thorough exposure of the fruitless expense and retarded development which have resulted from these old plans will lead to reform.

Except for a diagonal road, Kingsway, the plan of Ward 8 is strictly rectangular. The solitary diagonal thoroughfare was not the result of deliberate planning but arose through the existence of an old highway, laid out by the engineers of the British Army, the road between New Westminster and Vancouver, too important to be wiped out in making the subdivision.

It is always worth while in British Columbia to ask the question. " Does the plan fit the ground" ? On the plains of the middle west this question is not so pressing; but to run the streets in straight lines regardless of hills and valleys is a costly matter in undulating country. This fact is not so obvious in Ward 8 as in

some other subdivisions of Vancouver, because the ground is fairly level in the main. Even there, however, the defects of the plan adopted can be illustrated.

Fraser Avenue, which runs north and south in the centre of the ward, was made 99 feet wide instead of the usual 66 feet, so that it might serve as an artery for the principal traffic in that direction. And yet, with this object full in view, it was carried over the very highest portion of the southern ridge. (See contour map. Fig. 2). The original maximum grade was 16 per cent; but a deep cutting in the top of the hill reduced this to 5 per cent. Besides the cost of making the cut and lowering the cross streets, there was a great depreciation of the neighbouring property, which was made inaccessible to any but pedestrians. Claims for damages invariably result from every attempt to rectify such mistakes in the location of roads. And yet government departments and municipal bodies still continue to accept plans made with similar disregard of the topography. Even more striking instances of the result of such disregard are presented by the young city of North Vancouver.

It should be at least the second step in the consideration of a plan to ask if the entire area is adapted for building purposes, so that expense need not be incurred in the development of portions unlikely to yield a proper return. In Ontario, as a result of costly experience, the government has provided for official inspection and classification of township sites before acceptance of the plans. If such a requirement had existed in British Columbia, the plan of Ward 8 would have been very different. A large portion of the western half is practically dead level. This area was originally a lake, which was gradually filled up by the accumulation of silt and vegetable debris. It passed through the stage of muskeg, and is now reclaimed peat bog, Eighty acres, or more than one-fifth of the ward, are covered with this layer of peat to a depth of at least five feet. Unfortunately however, the average depth is nearer thirty feet; and piles forty to sixty feet long have been driven with ease in several places. It is never cheap and always unsatisfactory to build on such ground. The making of roads and the construction of sewers are both costly. Even a pipe sewer requires a pile foundation. Some six thousand dollars has been spent for piling alone for sewer construction in this bog area. But the ground is so unstable that the cost of upkeep of both roads and sewers will be heavy.

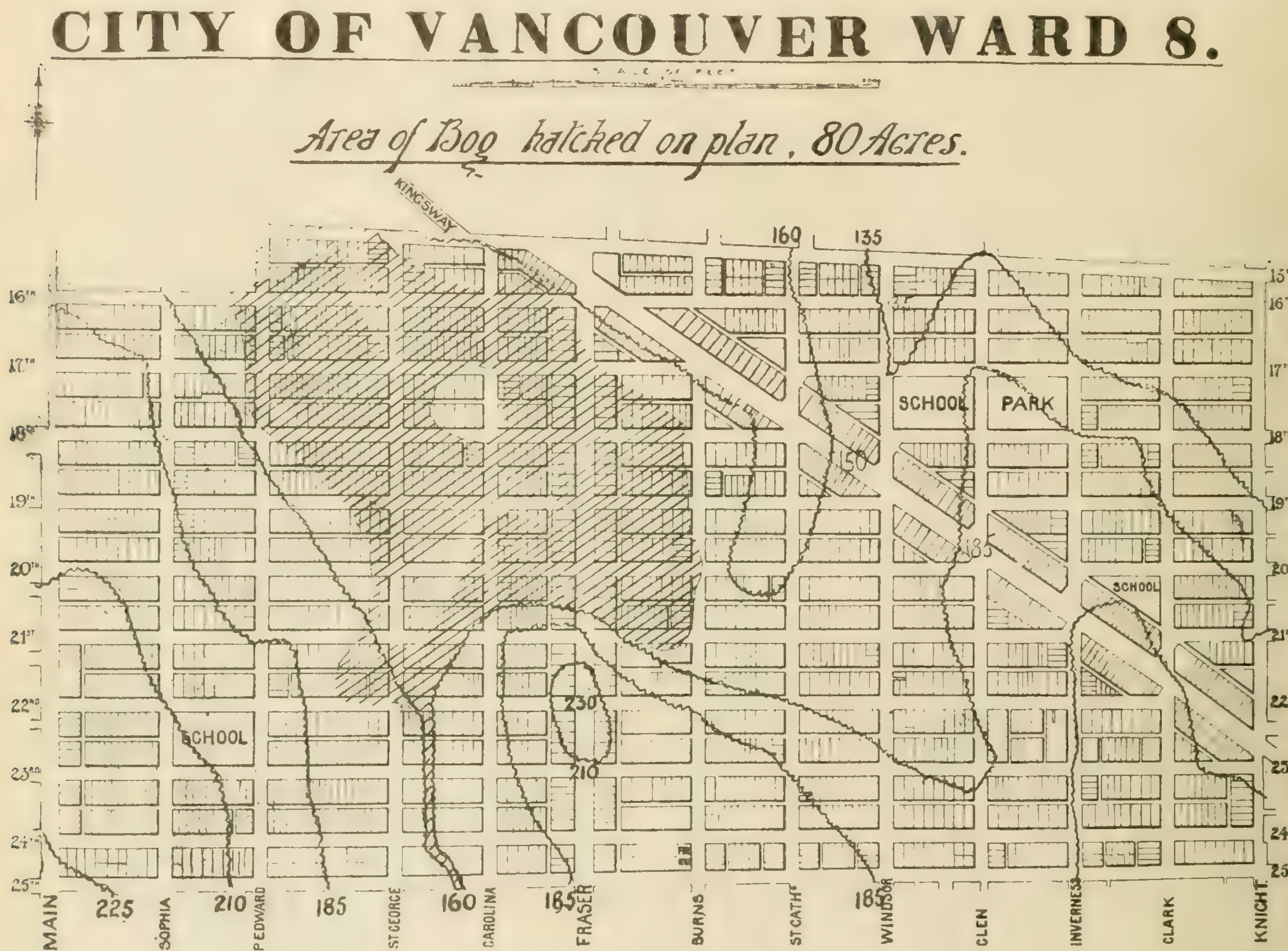

Fig. 2. Ward 8, city of Vancouver showing contours.

The shrinkage of the ground as it gradually drains causes lateral movements which have bent and occasionally broken the heavy timbers carrying the pipe sewers on the piles. Carolina Street on which the main branch sewer was laid settled two and a half feet during the construction. It was backfilled to grade but has again settled over two feet. This shrinkage is unavoidable, though the drying up which causes it is of advantage in every other way. But buildings of any kind, unless erected on very costly foundations are sure to settle unevenly on such ground. This uneven settlement leads to rapid deterioration of the property, which is very apt to degenerate into a slum. All such land should be reserved for park of agricultural purposes, and its division into building lost forbidden. The city of Manchester, England, owns two large areas of similar land, Carrington Moss and Chat Moss running to 3600 acres. These peat bogs are being drained and used as dumps for city refuse, and then cultivated intensively so as to make them a source of revenue. But the medical officer of the City informs the writer that there is no likelihood of these reclaimed areas being used for building purposes at any time, both for economic and sanitary reasons.

Ward 8. is not the only portion of the city of Vancouver which is partly covered by peat; and the adjoining municipalities contain many acres. It will be seen then, that there is ample room for goverment restriction for building on such ground.

There are other reasons for the exclusion of particular areas from development into building sites. In certain areas of Vancouver portions have been divided up into building lots which are traversed by wide and deep ravines. The carrying of streets across these ravines gives rise to very heavy expense. It has happened that good building land adjoining a ravine has been bought at great cost for park purposes, while the ravine itself, a natural beauty spot presenting a fine opportunity for the landscape architect, has been converted into an unsightly and unhealthy dump, pending its conversion into streets and building sites. The plan of Shaughnessy Heights (Fig. 3.) and the statement of the cost of its development will prove that a departure from the standard rectangular layout is not necessarily a source of increased expense. The straight north and south line of Granville Street was located before development began. All the other streets however, follow the contour of the ground closely, so that the cost of grading has been kept down

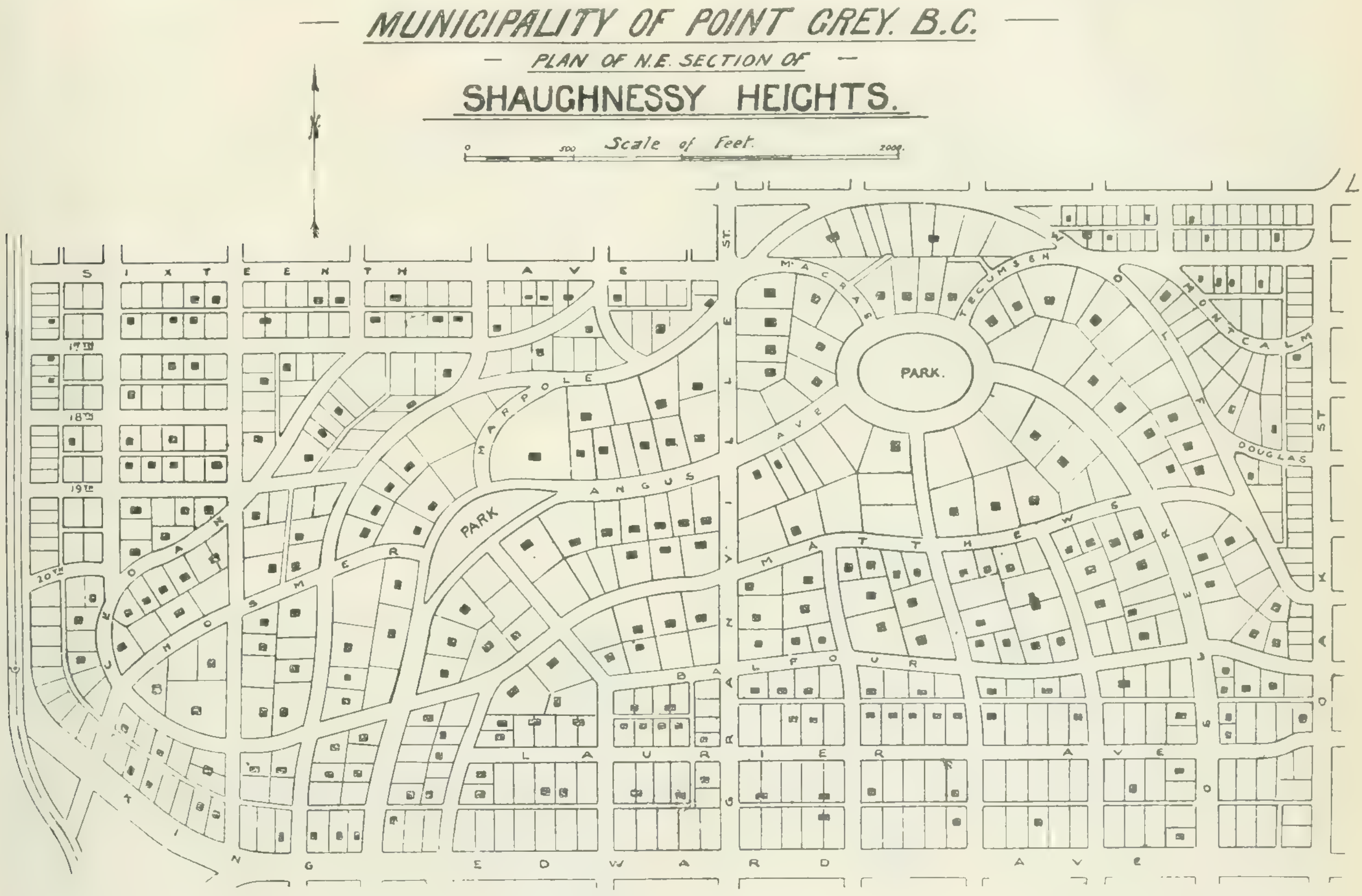

Fig. 3. Plan of Shaughnessy Heights, Point Grey, B.C.

and the depreciation of adjoining property through excessive cut or fill avoided. Moreover, as the entire area is adapted to residential purposes no money has been wasted in turning bad sites into good ones. The writer is indebted to the courtesy of N. J. Ker M.E.I.C. of the C. P. R. land department, for the details of the cost of development. Before however, making a comparison between Ward 8 and Shaughnessy Heights, it is necessary to put the areas on the same basis as far as possible, as the conditions of development are not exactly the same.

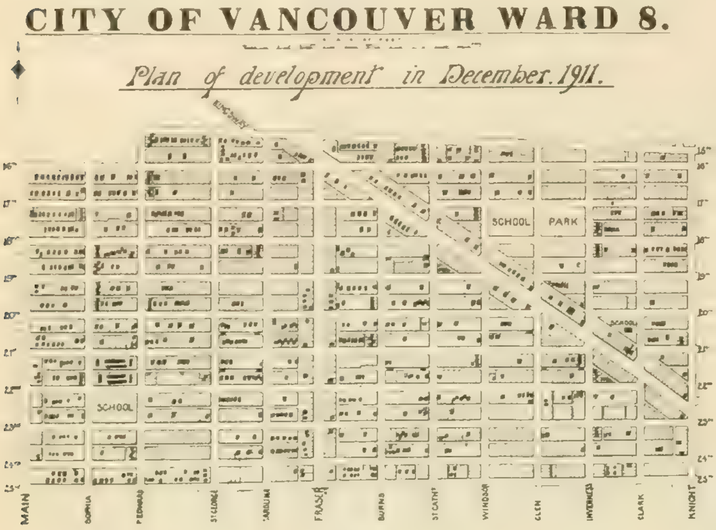

Fig. 4.

The plan of Ward 8 was registered as already stated in 1885. For at least twenty years there was no development except on the borders and at a few points on Kingsway. The land was in the hands of the provincial government, and the residents had no share in the control of the area or its improvement. Between 1907 and 1911 the development was very rapid and in the latter year the area was placed under the control of the city of Vancouver. The extent of the development when the area was handed over to the city as shown in Fig. 4. may be tabulated thus:—

Improved Lots	901	(out of 2373.)
Houses	856	
Stores and Rooms	13	
Apartment Buildings	1	
Industrial Buildings	11	
Public Buildings	4	
Population	3,300	

It is surely a reflection on a self-governing community that settlement to this extent should have been permitted under the administration of a Provincial Government without making any provision for water supply, sewers or sanitary accomodation. It was probably only the virgin character of the soil which prevented the outbreak of serious epidemics, as conditions in some parts of the area in 1911 were extremely bad.

The writer has not been able to ascertain what the provincial government spent in opening up this area. Most of the roads were cleared, Main Street, Fraser Avenue and Kingsway carried vehicular traffic, some of the other roads were rough-graded, and there were some plank sidewalks. But as the expenditure cannot be accurately given it has been entirely ignored.

Directly the city took over the administration, money had to be spent on a water supply; but very little could be done with the sewerage system until the trunk sewer was completed by the Joint Sewerage Board.

The development at the end of 1917 can be compared with that reached six years earlier by means of the plan, Fig. 5 and the following table:—

	1911	1917	Gain
Improved lots	901	1227	326
Houses	856	1130	274
Stores and Rooms	13	37	24
Appartment Buildings	1	2	1
Industrial Buildings	11	17	6
Public Buildings	4	9	5
Population	3,300	4,400	1,100

The writer counted the buildings at the end of November 1917; but the number of houses added must be somewhat discounted by the fact that 105 of them were empty, so that the total gain in houses may only be 170, as many of the empty houses were ruined beyond repair. The population is the estimate of the assessment commissioner, which must be considered a reasonable one.

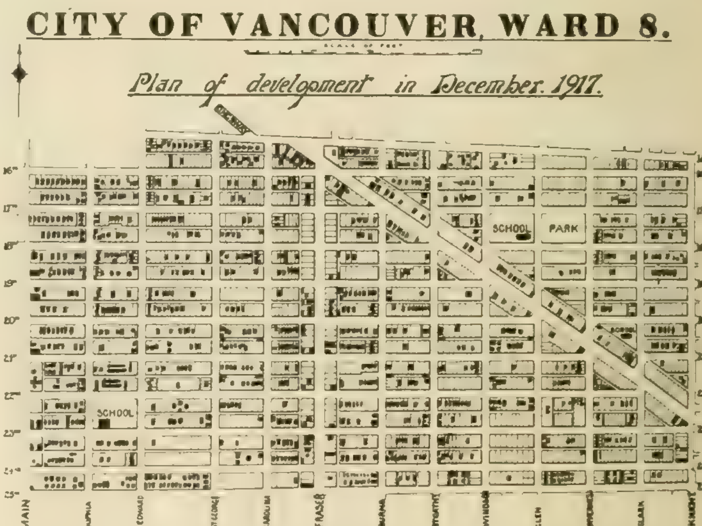

Fig. 5.

It is possible from the financial reports of the city accountant to trace the amounts spent within the area of Ward 8, and classed as capital expenditure. These figures do not include revenue expenditure, such as fire alarm system, water services, garbage collection, police and fire protection, street lighting, or any administrative expenses. Neither is there any allowance for cost of water mains or trunk sewers outside the area;

and some of the figures do not include loan expenses. But the objects of this paper can probably be secured without the inclusion of these items, which are difficult to apportion.

Capital Expenditure in Ward 8 from 1911 to 1917.	
Sewers, including trunk sewer	$389,000.00
Street and lane expenditure	261,270.00
Lane purchases	22,350.00
Schools, exclusive of Government School	238,089.00
Pavements	158,633.00
Watermains and hydrants	85,158.00
Park, 2½ acres	44,900.00
Fire Hall. (now closed.)	14,500.00
Total.	$1,213,990.00

An expenditure of $1,213,990.00. amounts to:—

$275.00 per capita on a population of 4,400.
$989.00 for every improved lot. (1227)
$511.00 for every lot. (2373)
$12.63 for every assessable foot frontage. (96,100).
52 per cent of the 1917 land valuation of $2,331, 570.00.

But this represents only partial development, as most of the roads are only planked, there are no cement walks in the Ward, and Fraser Avenue is one street which must eventually be paved.

The following is a conservative estimate of the cost of completing the development to the accepted city standards:—

Macadamize streets now planked	$ 90,000.00
Macadamize lanes	70,000.00
Cement sidewalks	136,000.00
Balance of Waterworks By-law	30,000.00
Complete sewers	50,000.00
Pave Fraser Avenue	100,000.00
	$476,000.00
If cement curbs are laid add	127,000.00
Total.	$603,000.00

Assuming that the cost of paving Kingsway, Main Street and Fraser Avenue is assessed over the whole area, the cost of street improvements alone, that is, paving, rocking, water mains, sewers, cement walks and curbs would amount to $15.00 a front foot, or $500.00 for a 33 foot lot on the existing assessable frontage.

Taking the assessed value of the land for the whole ward on the 1917 valuation, viz;—$2,331,570.00. the average value of the ward would be $9,455.00. per acre. This is equal to $873.00. for a 33 foot lot and $1,324.00. for a 50 foot lot. If this valuation appears excessive, it may well be remembered that the city purchased three blocks for school and park sites, a total of 7.2 acres at the rate of $19,472.00 per acre, which is equal to $2,726.00 for a 50 foot lot, twice the present valuation.

Valuation of land is a difficult matter. It is cheap if you are selling and dear if you are buying, so we may leave the value according to the city assessment. It can be discounted or added to as thought fit; but at this figure of $1,324.00 for a 50 foot lot, with cost of street improvements added, would represent a capital expenditure of $2,080.00 if the improvements were assessed equally over the whole area. If the cost of schools, parks, firehalls, etc., is added, the figure would be $2,270.00 on the present valuation. But if this is considered a war-time valuation and the normal valuation is to be at the rate at which the city purchased its school sites, the value of a 50 foot lot with improvements of streets, and a proportionate charge for schools and parks would be $3,672.00.

It has been stated already that the cost of city development carried out on existing methods is not likely to prove satisfactory either to capitalist or labourer.

Compare the assumed value of a 50 foot lot in this ward with a development that took place in Akron, Ohio, during the same period.

The Goodyear Tire and Rubber Co. found that their business was handicapped and the difficulty of obtaining suitable labour accentuated, because adequate and proper housing accommodation could not be found adjacent to their factory. They purchased 400 acres within two and one half miles from the business centre of Akron, and the area and distance from city centre thus corresponds very closely with Ward 8 in the city of Vancouver.

The Company's statement to its employees was as follows:—

" The average price paid for the property comprised in Goodyear Heights is slightly less than $300.00 per acre, which forms the basis for the value placed on lots. When the space necessary for the laying out of streets and sidewalks, parks and playgrounds is provided for, it is found that only about four lots can be laid out to the acre, which would make each lot value $75.00. The construction of the necessary cuts and fills for the streets, the construction of sidewalks, curbs and gutters, sewers and railroad bridge, the laying of water pipes, drains etc., and the paving, bring this amount up to an average of about $500.00. per lot. As some lots are more valuable in the way of location, view, etc. than the average lots, and some lots are less valuable than the average lots for the same reason, values must be adjusted by adding to the average price on the best lots and deducting from the average price on the less desirable lots. By so doing improved lots on the Goodyear Heights Allotment range from $240.00 to $760.00."

To return however to the consideration of the plan of the section of Shaughnessy Heights which was chosen for comparison, the total cost of developing this section was $841,000.00. exclusive of the clearing of the site, which was not considered in the expenditure on Ward 8.

The development is practically complete with the exception of the surfacing of the lanes which would probably add another $44,000.00. making a total of $885,000.00. This would include rocked roads and lanes, cement walks and curbs, park and boulevard improvements, sewers and water mains, with services to the lot lines.

As the cost of Granville Street pavement is not included in the above figures and neither schools and firehalls have been provided, comparison will have to be confined to street expenditure only, and this is approximately $760,000.00.

To place Ward 8 on the same basis the cost of the trunk sewer should be omitted, the paved roads considered as only rocked roads, and provide for the rocking of streets and lanes now planked or not surfaced. To do this and complete the streets with cement walks to the standard of Shaughnessy Heights (which is below the accepted city standard), would cost approximately $1,080,000.00 or 42½ per cent more; whilst if sewer and water services were included, the additional cost would be 50 per cent.

We have thus two districts of equal area, at equal distances from the centre of the city, and developed at the same time under the same market conditions. The high class residential district has been developed as far as its streets are concerned, at practically half the cost of the working class district, because we must remember that every item of expenditure is included in the Shaughnessy Heights account, whilst in considering Ward 8 nothing whatever was included for the preliminary work necessary to provide for a population of 3,300 previous to the city taking control in 1911.

It is instructive to consider just what it costs to allow a population to scatter itself all over an area, as has happened in Ward 8, compelling the instalment of a full street service for the benefit of perhaps three or four houses only. The statement in the table is based on the 1917 population of 4,400.

Street frontage	29 miles or 34 feet per capita.
Watermains	17 miles or 21 feet per capita.
Sewers	11 miles or 13 feet per capita.
Hydrants	102, or one to every 43 persons.
Arc lamps	148, or one to every 29 persons.

As the B.C. Electric Railway Company have kept this ward as a separate district, the writer is enabled by their courtesy to give the total consumption of electricity in the ward for private lighting for twelve months. It amounts to 158.035. K.W.H.; and whilst the consumption of electricity for street lighting is not so accurately metered, it can be very closely approximated, as the whole of the district is served with the new efficient nitrogen lamps, and the consumption is estimated at 155,783. K.W.H.

In Shaughnessy Heights, the number of arc lamps is 93 as against 148 in Ward 8, and their efficiency is not as high. The demand for the extension of street lighting if often heard, and the argument is advanced that the people like well-lighted streets, and are willing to pay for the benefit gained. A very little examination however, will show that the people who make the demand and obtain the benefit do not always pay. It has been shown for instance in the case of Ward 8, that the assessed value is $2,331,570.00. which at the present tax rate of 24 mills produces a revenue of approximately $56,000.00. but the capital expenditure of $1,213,990.00. at 5 per cent means a fixed charge of approximately $60,700.00. so that the cost of electric lighting, maintenance and service charges of all descriptions has to be obtained from other sources. It is therefore quite clear that if all city extensions are developed on similar lines, the burden will become too great for the business and industrial sections of the city to carry.

That the nature of the plan has a great deal to do with the cost of development can be shown by the proportion of street area to building area. 33 per cent of Ward 8 is taken up with streets and 5 per cent with lanes, leaving only 62 per cent for building development of which the city has taken 2 per cent for park, school sites and firehall, leaving the figures as 60 per cent of private land 40 per cent city land. That this is not exceptional and due to some peculiarity of the subdivision, it may be compared with other sections of the city of Vancouver. In the West End the streets and lanes average 36 per cent of the area, in Fairview 35 per cent, whilst in Hastings Townsite one subdivision with streets alone and no lanes runs as high as 39 per cent.

In Shaughnessy Heights the streets form 29 per cent and lanes 2½ per cent of the area. This however rockens the whole width of Angus Avenue as a street, though it has a wide parking strip in the centre. The following table shows the distribution of acreage in the two selected districts.

Ward 8. Acres.		Shaughnessy Heights. Acres.
252.6	Building Area.	268.8
138.6	Streets.	115.2
21.2	Lanes.	10.2
2.4	Parks.	5.8
414.8		400.0

The purpose of a street is at least twofold. It gives access to the property, and serves to maintain a clear space between buildings and thus prevent overcrowding. It is quite clear that one third of the land throughout the whole city area is not required to carry the traffic of the remaining two-thirds.

The density of population in Ward 8 at the present time is only 11 per acre, a very low figure. In this narrow sense there is no overcrowding; which is true of the city as a whole, as 11 persons per acre is the average for the city, and no ward in the city has a population density above forty per acre, though there may be a few blocks where the density is very much higher.

But even before the city took charge of Ward 8, and before watermains and sewers had been constructed, buildings were erected in it, not singly but in groups and blocks, in such a way that they would not have complied with the building regulations of any town in England as regards air space, even if we take such regulations as were in force as far back as 1885, when the original plan of this area was registered. All modern town planning schemes, of course treat these old regulations as quite inadequate in the light of modern knowledge. Fig. 6, shows a block of nine houses erected in Ward 8, previous

to 1911. Six of these houses would not comply with England building regulations for air space, and similar illustrations could be given, not only in this ward but throughout the city. Fig. 7, shows a series of houses

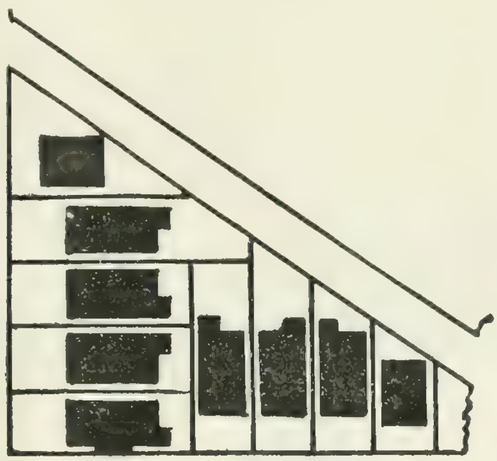

Fig. 6. Plan of block of nine houses, ward 8, Vancouver.

on 25 foot lots, built in the ward. While 25 feet is ample frontage if the buildings are properly planned, the mistake with these houses is that they are designed as if to be built on a 50 foot lot. Many of the rooms have no proper lighting through insufficient side space, the neighbouring houses shutting off the light from the side windows. The Englishman's home built on a 15 foot frontage with proper regard for air space is a healthier dwelling.

Fig. 7. Series of houses on twenty-five foot lots, ward 8, Vancouver.

Wide streets secure air space in one direction; but if the width of streets is excessive and the cost of building ground is thereby raised unduly, buildings may be so congested through the use of narrow lots that air and light are not given where they are required. Air space means light space too; and many buildings in Vancouver have too little space at the back for proper access of light.

Consider for a moment who occupy the back rooms of a house during daylight hours. Are they not the mother and the children under school age? And are not these the persons most subject to tuberculosis and other diseases which result from defective housing and want of light and air?

The diagram (Fig. 8), shows a comparison between the death rates in Vancouver in 1913 and 1917. The total difference in the number of deaths is only 11, but note how the cause of death through tuberculosis is increasing, whilst typhoid is decreasing owing to the extension of a pure water supply and the provision of sanitary facilities. Medical men are agreed that air and light are the two essentials to stay the ravages of tuberculosis.

Badly lighted and defective houses bear a double curse. In a social survey the writer once made in England he was struck by the fact that tuberculous people often occupied the most unsatisfactory houses. It did not necessarily follow that they contracted the disease in

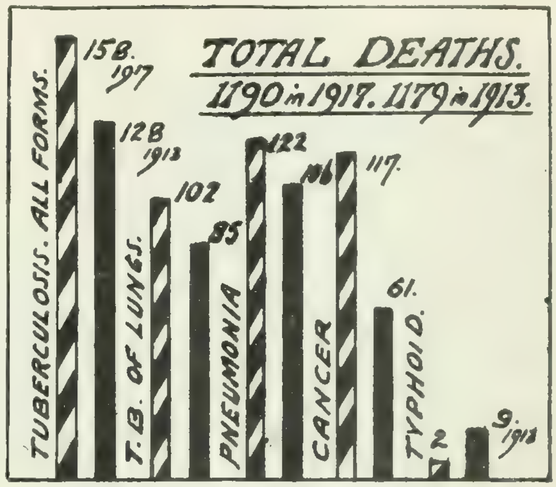

Fig. 8. Death rate diagram.

these houses; but everyone can realize that continual sickness means a heavy drain on the income, and this makes it necessary to get a cheap house. A badly lighted or otherwise unsanitary house is shunned by those who can afford to pay; so the poor and the sick drift into this type of house and go from bad to worse.

In the table of cost of development in Ward 8, an item appears as lane purchases. This will bear explanation. Whilst the total lane allowance amounts to 5 per cent of the area, the lanes are not all dedicated to the public, but some are held as lots. In the original sub-division this was presumably done so that if anyone purchased a whole block and did not wish to sub-divide, the lane need not be opened. But when once a block began to be sold in lots, its lane ought to have been opened up. Instead of this it was held as private property and houses have in some cases been built on the lanes. Fig. 9 shows anomalies which the holding of these lanes as private property has caused. The southern half of the block shown was originally sub-divided into eight

lots similar to those shown on the northern half; but the owner of five of these lots considered that they were too large, and desired to make nine lots out of five. To carry out this plan it was necessary that there should be a lane; and as the original lane allowance was held as a private lot, another lane allowance had to be dedicated. Later on the city purchased the original lane allowance;

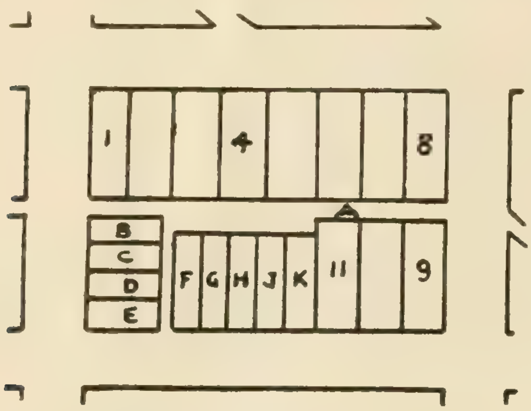

Fig. 9. Anomalous lane allowance.

and now we have a lane with a swollen center of no value to anyone. By the resubdivision of the lots the air space has been reduced, the fire hazard heightened, the area of the land to be maintained by the community increased, and the value of the adjoining lots depreciated. Who benefits in this case except the original land speculator?

Take another illustration to show how for want of proper regulation all the expense which has been gone to for purchase and development and upkeep of lanes has been thrown away. Fig. 10 shows the back of a tenement house which was erected so that the front of the building faced on the flankage street. The back of the building thus comes to the side of the adjoining lot, to the great detriment of the property as is clearly shown. The depreciation may ultimately be so serious as to make the house valueless. The owner will thereupon remove it and build a similar tenement or apartment building. If he chooses he may so build that there will only be four feet of space between the back of the old building and his new building, this would practically ruin the older building, and in any case would make it a sanitary menace. The value of the lane as a means of securing light and air and preventing over-crowding being altogether nullified.

Fig. 10. Tenements erected to detriment of adjoining property.

From this example it can be seen that building restrictions, properly enforced, perform at least three functions. They protect the public health, preserve and stabilise real estate values, and prevent excessive cost of city development.

Fig. 11. Home built by retired farmer.

Illustrations of these points may be given. Fig. 11 shows a house to which little exception can be taken as a middle class residence. Such a house might, for instance, be occupied by a retired farmer bringing his family to the city to secure educational or business facilities. Naturally the purchaser of such a house expects his neighbours to build somewhat similar houses adjoining his. What we do find however opposite to this house is shown in Fig. 12. a Chinese laundry now disused, but none the less unsightly and a menace. Everyone will admit that the house opposite such a building is lessened in value through its erection. But the laundry has done something more; for it has effectually stopped the development of the block. As a matter of fact there are two blocks in this instance, each with one Chinese laundry and one house, which was probably built before the laundry. No further building of houses is likely to take place until this menace is removed. But the city has to provide and maintain the roadway, sidewalks, sewers and watermains just the same as if the block were fully occupied by revenue-producing property, and the population which ought to fill it is scattered.

Fig. 12. Chinese laundry opposite home shown in fig. 11.

It may be difficult to prevent an owner building just what he likes on his property, unless definite zones are prescribed for different classes of buildings. But unless some restrictions are enforced, the damage done by one unsuitable building may be very great not only to adjoining property owners, but also to the community as a whole.

It was stated that whilst the area in Ward 8 was still an unorganized district, buildings were erected with less air space than would have been called for in England. Figs. 13, 14. give another illustration, an apartment building occupying the entire width of the lot in front and dependent for access of light and air on each side upon the adjoining lots remaining partially developed. It is recognized in law that a property owner must not allow noxious weeds to grow on his property to the detriment of his neighbour's land. It should also be made a legal principle that no property owner can erect a building the successful use of which is dependent upon the adjacent lots remaining vacant or only partially developed.

Fig. 13. Apartment building occupying entire width of lot in front.

Unless building regulations are more intelligently framed and buildings of this description made impossible, the city will be faced with a serious problem in a very short time.

An illustration from another section of the city (Figs. 15, 16) shows what may happen. A tenement building was erected in a neighbourhood where there was not the slightest necessity to crowd the people into a building of this class. Here again light and air were stolen from the adjoining lots, and one owner to protect his property erected a high fence. This at once spoiled the new building, and it is doubtful if the revenue produced from it has even paid the taxes. Buildings of this description are being erected all over the city, not only in frame construction but in brick and concrete, and on land where the adjoining lots cannot long remain vacant because of their high value. When light and air are shut off by the utilization of the neighboring lots, the buildings will rapidly depreciate in value and may also become a sanitary menace. Even now they are detrimental

Fig. 14. Incongruity of allowing apartment building shown in fig. 13 to be erected.

to the district because they retard the development of adjoining lots on reasonable lines. An owner will not put up an ordinary building with proper side space in the same block, because of the fear that when he has done so his neighbour will take advantage of the space he has left, and erect a building such as that illustrated. Hence development is checked, and the population which would naturally fill up the remainder of the block is compelled to leave the lots vacant and move further out. All city utilities have to be extended to provide for the population which is thus forced to scatter. What is sanitarily unsound cannot be economically stable. Illustration of the truth of this is found in the fact that out of the 105 empty houses counted in Ward 8 a large proportion were built on the backs of lots or unduly crowded. They were thus the first to be shunned when a choice of houses was possible, and empty houses rapidly deteriorate. American cities are finding what is termed the obsolescence of buildings (that is their falling out of use through failure to serve the purpose for which

they were erected) a very serious problem, and loan and mortgage companies are giving the matter great attention.

Some of the defects of the existing methods of city development have been pointed out, and their economic and sanitary bearings. To remedy these defects the first essential is a thorough investigation, by men who know what sort of investigation is needed, and men who are conversant with city problems. In a case of this kind there ought not to be any hesitancy about obtaining help from men who have studied these problems elsewhere. We may solve our own problems unaided, but pay dearly for our experience. After investigation must come education. If the people understand the problems before them, they will more readily submit to the changes necessary, some of which will be very severe and far reaching. The genius of the American nation has been shown in the courage which leads it to scrap all machinery that is out of date, and to adopt bold policies of reform. In the past the British have perhaps relied too much on the excellence of their machinery, and clung to traditional customs and institutions; but in the matter of town planning the British have shown more courage than the Americans. In Canada we have the British and American genius combined; the courage to scrap and the ability to plan for permanence should both appear as soon as the need for them is brought home to the mind of the nation.

Fig. 15. Type of apartment built in residential district menace to adjoining property.

In the 1917 Report on City Planning Progress issued by the American Institute of Architects, the following statement appears.:—

"The Committee has laid particular stress on the economic and engineering side of city planning, because it believes that this is foundamental to progress, and while as architects, the members of the Committee are necessarily strongly interested in the esthetic side of city planning, they are firmly convinced that City planning in America has been retarded because the first emphasis has been given to the "City Beautiful" instead of to the "City Practical." They insist with vigor that all City planning should start on a foundation of economical practicableness and good business; that it must be something which will appeal to the business man, and to the manufacturer, as sane and reasonable."

This extract shows the commonsense attitude which has been taken by the architectural profession in American.

In Canada, our governments and city administrators must realize that the economic competition of the future can only be met by planning on a wide scale and on the most efficient basis. All waste must be eliminated, and cities must be laid out in the most convenient, healthful, and business like way, to meet the intensive phases of life and business which are certain to follow the termination of the war. France and England, though engaged in a desperate struggle, are yet busy with City planning; and we should profit by their example and set our cities in order, or else we shall be left far behind in the great economic race of the future.

If we enter upon this work with true foresight and vision, and carry it on earnestly and steadily, it will be the most striking contribution that the citizens of to-day can make to the welfare of those of to-morrow.

Fig. 16. High Fence built by householder adjoining apartment shown in Fig. 15.

The largest share to that contribution ought to be taken by the Engineers of Canada.

Draft of Proposed Act for Engineers.

Herewith is presented to the members the wording of an Act, subject to modification and correction, proposed to be presented to the Legislature of the province of Saskatchewan.

It is quite likely that before this Act is finally ratified by Council it will not be recognized by its most intimate acquaintance. Its publication herewith is designed to bring this question to the attention of all the members in order that it may receive the fullest possible discussion.

An Act Respecting the Engineering Profession

His Majesty by and with the advice and consent of the Legislative Assembly at Saskatchewan enacts as follows: —

Short Title

1. This Act may be cited as " The Engineering Profession Act."

Interpretation

2. In this Act, unless the context otherwise requires the expression: —

(a) " Registered Engineer " means any person qualified under the provisions of this Act to practice as an engineer in Saskatchewan.

(b) " The Institute " means the Engineering Institute of Saskatchewan.

(c) " Council " means the Executive Council of the Engineering Institute of Saskatchewan.

(d) " Chairman " means the chairman of the said Engineering Institute of Saskatchewan or the officer presiding for the time being at any general meeting of the Engineering Institute of Saskatchewan.

(e) " Registrar " means the Secretary-Treasurer and Registrar of the Engineering Institute of Saskatchewan.

(f) " Board " means the Board of Examiners.

The Engineering Institute of Saskatchewan

3. The Engineering Institute of Saskatchewan hereby incorporated is composed of the corporate members of the Saskatchewan branch of *The Engineering Institute of Canada* heretofore incorporated under the name and style of *The Engineering Institute of Canada*, as at date of passing of this Act and all corporate members of *The Engineering Institute of Canada* upon being duly registered as hereinafter provided and all other persons who shall hereafter be duly registered shall while so registered be members of and form the Engineering Institute of Saskatchewan, and the said Institute shall be a body politic and corporate with perpetual succession and a common seal.

4. The Institute shall have power to acquire and hold real estate not producing at any time an annual income in excess of five thousand ($5,000) dollars, and to alienate, mortgage, lease or otherwise charge or dispose of such real estate or any part thereof as occasion may require; and all fees, fines and penalties receivable and recoverable under this Act shall belong to *The Institute.*

By-laws

5. The Institute may pass By-Laws not inconsistent with the provisions of this Act, for:—

(a) The Government, discipline and honour of its members.

(b) The management of its property.

(c) The maintenance of the Institute by levying fees not in excess of $25.00 per annum.

(d) The examination and admission of candidates for the practice of the profession.

(e) All other purposes reasonably necessary for the management and working of *The Institute.*

6. All by-laws or changes thereto shall be prepared by the Council and shall before becoming effective, be ratified by two-thirds majority of the votes received from the members of the Institute in good standing.

Who May Practice

7. (a) Only such persons who are members of the Institute hereby incorporated and registered as such under the provisions of this Act shall be entitled within the Province of Saskatchewan to take or use the name and title of " Registered Engineer " or any abbreviation thereof, either alone or in combination with any other word or words and no other person shall use any name, title or description implying that he is a member of the Institute or act as engineer, report on design, laying out, advising on, or supervising the construction of any public work upon which public money is expended, the cost of which shall exceed $1,000.00.

(b) Engineers practicing in Saskatchewan at the date of passing of this Act, who are not members of *The Engineering Institute of Canada* may be registered within one year of the passing of this Act without having to submit to examination provided that their credentials are approved by the Board.

In the case of engineers who have practiced in Saskatchewan and who have been accepted for Overseas Service in the present war in the Service of His Majesty or any of the Allies of Great Britain, having approved credentials, the year for registration is to date from their return to Saskatchewan or their discharge from the service, which ever shall first take place.

(c) Corporate members in good standing of *The Engineering Institute of Canada* and who are not resident in Saskatchewan, shall on application to the Council and on payment of the prescribed fees, become and be duly registered members of the Institute.

(d) Engineers who are members in good standing of engineering institutions or societies, duly recognized by the Council, upon presentation of credentials satisfactory to the Council and upon payment of the prescribed fees, shall be granted a permit to practice for a period not exceeding one year.

(e) Engineers not resident in the province of Saskatchewan shall be given temporary permits by the Institute in case of employment by public corporations or any public body, but such engineers shall act only in an advisory capacity to a registered engineer.

Partnership

8. In case of two or more engineers carrying on their practice in co-partnership, each person whose name appears as a member of the firm shall be registered under this Act.

Advertising

9. It shall be unlawful for any person not registered under this Act to advertise or put out any sign or other device for the purpose of or with a view to indicating to the public that he is entitled to practice as an engineer within the meaning of this Act.

Seal

10. Every engineer registered under this Act shall have a seal, the impression of which must contain the name of the engineer, his place of business and the words "Registered Engineer, Saskatchewan" with which he shall stamp all engineering reports, working drawings, tracings, specifications and contracts prepared and issued by him for use in the province of Saskatchewan.

Suspension for Misconduct

11. The Council may, in its discretion, fine or suspend or fine and suspend. or expel from *The Institute*, any engineer guilty of negligence or misconduct in the execution of the duties of his office. The Council shall not take any such action until a complaint under oath has been filed with the Registrar and a copy thereof forwarded to the party accused. The Council shall not suspend or expel an engineer without having previously summoned him to appear to be heard in his defence, nor without having heard any evidence under oath offered in support of the complaint or on behalf of the engineer. The Chairman of the Council or person acting as such in his absence, or the Secretary is hereby authorized to administer oaths in such cases. All evidence shall be taken in writing or by a duly qualified stenographer.

(a) Any engineer so expelled or dismissed may, within 30 days after the order or resolution of suspension or expulsion, appeal to a Judge of the Supreme Court from such order or resolution, giving seven days' notice of appeal to the Council, and may require the evidence taken to be filed with the proper officer of the court, whereupon such Judge shall decide the matter of appeal upon the evidence so filed and confirm or set aside such suspension or expulsion, without any further right of appeal; and if the suspension or expulsion be confirmed, the costs of such appeal shall be borne by the engineer.

(b) Unless the order or resolution of suspension is set aside on such appeal, or the Judge or the Council otherwise order, the engineer so suspended or expelled shall not practice further, except (in case of suspension) upon expiry of the period of suspension. Pending an appeal the engineer so suspended or expelled shall not practice.

(c) The Council may suspend or expel from *The Institute* any member convicted of a criminal offence by any Court of competent jurisdiction.

Penalties

12. Any person offending against any provision of this Act shall be liable on summary conviction to a fine of not less than $25.00 and not more than $100.00 for every day during which such offence continues, and in default of payment, to imprisonment not exceeding six months. And no fee charged for work done in contravention hereof shall be recoverable.

Evidence

13. The Certificate of the Registrar under the seal of *The Institute* shall be prima facie evidence of registration or non-registration as the case may be.

Examinations

14. (a) Examination of candidates for admission to *The Institute* shall be conducted by a Board of Examiners composed of two members of the Engineering Faculty of the University of Saskatchewan and two members of *The Institute* nominated by the Council, which Board shall be under the chairmanship of the Dean of the Engineering Faculty of the University of Saskatchewan. The Chairman of the Board shall vote only when there is a tie.

(b) The candidate shall pass an examination before the Board of Examiners of *The Institute* on the theory and practice of engineering and especially in one of the following branches at his option: railway, municipal, hydraulic, mechanical, mining, chemical or electrical engineering.

(c) The Registrar shall act as Secretary to the Board of Examiners.

(d) Examinations shall be held at the University of Saskatchewan at such times as specified by the Council.

(e) Each member of the Board before assuming the duties of an examiner shall take and subscribe an oath of office as in Form...... in the schedule of this Act before a Notary Public or Commissioner for Oaths and kept with the records of *The Institute*.

(f) Fees to be charged for examinations shall be fixed by the Board.

Vocational Training for Returned Soldiers

Work being done at Toronto and McGill Universities.

Professor H. E. T. Haultain, Vice-President, E.I.C., Vocational Officer for the Province of Ontario, in charge of the Vocational Branch of the Invalid Soldiers' Commission of the Department of Soldiers' Civil Re-establishment.

University of Toronto.

A number of the members of the instructional staff in the Engineering Faculty of the University of Toronto are now engaged in the training of returned soldiers along vocational lines. The policy of the Department of Soldiers' Civil Re-establishment having this matter in hand has been to offer courses of instruction for men who through partial disability are no longer capable of following their pre-war occupations. Generally also, the course of instruction is one to which the soldier's previous occupation will contribute something in both knowledge and experience so that his new field of endeavor is not entirely strange and unknown. Men who are eligible for instruction, that is, men who are incapacitated from following their old occupations are carefully classified by the officers of the Department of Soldiers' Civil Re-establishment, and allotted to classes to which they seem to be fitted either by experience or inclination. These men are often subsequently further classified by the instructor according to their preparation and aptitude. The courses of instruction cover from three to eight months.

At the present time the work of instruction is carried on in the class rooms and laboratories of the engineering buildings but as these will not be available for this purpose on the return of the regular students in the autumn, other space is being provided through the completion of the second story floor in the museum of the mining building. This will place 7,000 square feet of floor space at the disposal of the staff for this work.

The character of the instruction must depend to a very great extent on the previous education of the men. For instance, an intelligent mechanic can be taught to interpret plans and specifications, to estimate quantities therefrom, to use the scale and to consult a handbook for tabulated information. Such a man may make a first-class inspector on construction or he may undertake contracting on his own account. A lad who has had a good high school education and who is accurate at figures can be trained so that he will fill a useful place in a contractor's organization or possibly in an engineer's office. Occasionally, though infrequently, a man is found whose previous training and natural aptitude qualify him to undertake intelligently problems in design of moderate difficulty. The demand for men of this type is today much greater than the supply. All of the three types indicated above are represented in the vocational classes at the University of Toronto.

In some cases it is found expedient to give instruction to men at the University during the afternoons only, the forenoons being devoted to learning the technique of some trade in a shop or factory. This arrangement is being worked with a group of men who are under training at the factory of the Russell Car Company during the half of each day. Here they learn the usual operations of the machine shop such as turning, milling, planning, bench work, etc. During their afternoons they receive instruction in drafting, computations and the principles of machines and mechanics.

Courses have been established in the following subjects:

Ore Dressing.
Quantity Surveying and Plan Reading.
Motor Mechanics.
Farm Tractor Operation and Repair.
Electricity as Applied to Industries.
Wireless Telegraphy.
Electricity.
Machine Shop Calculations and Plan Reading.

Classes in other subjects are planned and will be commenced as soon as there is sufficient demand for them. There are approximately 100 men in attendance now. The classes have been running about four months and already a number of men have been placed in good positions, demonstrating that where men are really in earnest, they can be greatly helped by the comparatively short course.

The method of instruction which has been found most effective may be termed that of practical demonstration. An elementary text-book is used and definite lessons are assigned to be studied at home. The principles are then demonstrated on the machine in the laboratory. As new students are being enrolled every day, one of

the problems is to give the instruction without too much overlapping. This of course, necessitates the employment of a larger number of instructors than would otherwise be necessary.

Members of the Engineering Faculty Staff who are undertaking this work are Professors Arkley, Gillespie and Price and Messrs. Guest, Margison, King, Dyer, Watson and Zimmer.

Memorandum Re Pensions and Vocational Training

In May 1918 there was published a Returned Soldiers' Handbook, by authority of the Minister of Militia and Defence. Article 120 on page 58 reads:—

"All pensions awarded to members of the force shall be "determined by the disability of the applicant without reference "to his occupation prior to enlistment."

Article 121 reads:—

"No deduction shall be made from the amount awarded to "any pensioner owing to his having undertaken work or perfected "himself in some industry."

Training Series No. 1 of which 5,000 copies were issued in March 1918 from the office of the vocational officer for Ontario contains this statement:—

"Taking education classes will not influence your pension in "the slightest degree—absolutely."

An information card issued to all soldiers by the Military Hospitals Commission in 1917 contains this statement:—

"His pension cannot be reduced by undertaking work or "perfecting himself in some form of industry."

The Soldiers' Return, a leaflet issued by the Military Hospitals Commission to all returned soldiers contains this statement:—

"He gets a pension or gratuity in proportion to the disability."

"Is it dead sure that if a man works hard and betters himself "his pension cannot be cut down on that account?"

"Not by one cent—the law declares that no deduction shall "be made from the amount awarded to any pensioner owing to "his having undertaken work or having perfected himself in some "form of industry."

The same idea has been repeated in a great many other publications. The Military Hospitals Commission Bulletin No. 3, December, 1916, on page 2 contains the following:—

"Both in France and Germany one of the greatest obstacles "in the way of training the disabled has been the men's fear that "their earnings will be made a pretext for reducing their pension. "In Germany this has been so marked that this state of mind "has been named 'pension hysteria'. It is vital to the success "of any systematized training that it should be made clear to the "men that the pension is based on the degree in which earning "capacity has been impaired, and not the actual earnings."

It is quite true that a man may receive temporarily a fairly high rate of pension and that after some months this may be cut down but this reduction of temporary pension rate is due to the reduction in the man's physical disability, the partial or complete recovery from his physical defect or illness. It is governed by medical examination.

It may be that in this period of recovery the man has also learned a new trade and new earning powers but the pension is governed entirely by medical examination of the physical defect.

To cut the man's pension because he had the ambition and ability and application to learn successfully a new trade would be entirely contrary to the spirit and policy of the Government.

H. E. T. HAULTAIN,
Vocational Officer for Ontario.

McGill University.

The work along this line being done at McGill University is covered in an article in "Reconstruction" published by the department of Soldiers' Civil Reestablishment.

"In the early autumn of 1917, arrangements were made with the authorities of McGill University for accommodation in their buildings, to enable the Department of Soldiers' Civil Re-establishment to carry out portions of its industrial re-education policy in Montreal. The building best adapted to its use was the MacDonald Engineering Building, and through the generosity of the dean and the members of the faculty the department was enabled to have complete use of the machine shop every morning in the week and two afternoons. The University also turned over the electrical laboratory for three full days per week; the telegraph room, full time; as well as the use of the thermo-dynamic laboratory, boiler-room and power house for the steam engineering."

"The advantages accruing from the use of the above have been inestimable. The plan is to place men in these various laboratories and shops for a portion of their course, where they will receive a thorough grounding along theoretical and practical lines. This will enable them, although only students, when they are sent out to industries, to carry on as useful men in concerns which have to pay dividends.

"As a practical instance of this, the case might be cited of a man who, previous to enlistment, had been an electric wireman by trade, his chief occupation being the stringing of wire on the streets. He returned to Canada with a compound fracture of the left arm, and when his case came up for re-ducation he stated that he wished to become an electrical foreman. He spent six months in the electrical laboratory at McGill, where for three days in the week he received practical and theoretical instruction. During the remaining two and a half days he worked out problems in the draughting room, which were set for him by the instructor, during laboratory periods. In this manner he received a thorough theoretical training as well as practical work on the various machines in the laboratory. The remaining two months of his course he spent as assistant to the foreman in the electrical department of a leading industrial concern in Montreal. On the completion of his course he was given entire charge of the electrical plant as representative of this same concern in another town, and is making good. Incidentally, he is earning double the wages which he did before enlistment.

"In order to make the matter quite clear another illustration might be given, that of a French Canadian who previous to war had been engaged as a teamster. He returned to Canada and during his convalescence learned to read and write. He was still convalescing when he entired the machine shop at McGill. There he spent four months, and after receiving his discharge preferred to go to work rather than to take up a re-education course. He went to a large industrial concern in Montreal as a machinist's helper. He was soon promoted to a machine of his own, and after he had been there a very few months was made a sub-foreman. He is now foreman in another of the shops and earning splendid wages and attributes his success to the grounding he received in the machine shop at McGill University.

"Thus it may be seen that the system of utilizing these shops applies not only to industrial re-education cases, but also to cases of occupational therapy.

"It should be noted that the Science Faculty did everything in its power to arrange its classes in such a way that the department might make the fullest use not only of its laboratories and shops, but also of its instructors."

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOL. I. NO. 7 NOVEMBER 1918

The more VICTORY BONDS you buy the more satisfied you will be. At the same time it is hoped you will not forget the TOBACCO FUND, to which it is your privilege to subscribe. In anticipation of your subscription, arrangements are being made to send the parcels overseas by the 10th of November.

Legislation

No single subject is occupying the minds of engineers throughout Canada at the present time more than the question of securing legislation designed to protect the public from the wilful expenditures of public money due to incompetent engineering advice or supervision and to elevate the status of the engineer, to the extent at least that he will have legal standing in connection with the expenditure of public money for engineering work.

A special meeting of Council was held on October 1st, at which several hours were devoted to discussion of this subject. Council realizes that there is an insistent demand for legislation throughout Canada and it was resolved that it was desirable to encourage securing legislation in the various Provinces. At this meeting the Secretary was instructed to write the Secretary of the Saskatchewan Branch a letter containing the following:—

> "That inasmuch as other branches of *The Institute* are "working on Acts affecting the engineering profession in various "provinces, it is highly desirable that such Acts should be as "uniform as possible. Therefore Council considers that in "addition to the splendid work you have done, the reports from "other branches should, in all fairness, be considered before setting "a final seal of approval on any single draft."

From the discussion which had already taken place at some of the western branches it is quite evident that at the moment there is considerable diversity of opinion as to the definite form which legislation should take and that much discussion must follow before a draft Act can be prepared which has been agreed to by all branches and approved by Council.

Since the original draft was made by the legislation committee of the Saskatchewan Branch, both the Saskatchewan and Manitoba branches have suggested many changes which show clearly that this question is one which must not be hastily dealt with. It has been agreed that no move will be made in any Province until application can be made for an Act which has had general approval. In this connection the decision of the Vancouver Branch is notable. At a general meeting of the branch held on October 9th, to consider the question of an Engineering Profession Act a number of resolutions were adopted, all of which deal with the question in a general manner and are as follows:—

1. That this Branch approves of the movement to secure some legislation to license or register engineers, and will further the movement within the Province on lines agreed upon by the total membership of *The Institute*, and approach the Legislature as soon as a succesful issue is probable.

2. That this Branch considers that it is wise to limit the movement at the beginning to the registration of engineers who undertake public work.

3. That the principle of associating members of the University staff on the examining board is approved.

4. That the principle should be established that any member of the profession, qualified to practise in any Province, should be free to practise in any other Province, without any enquiry

or examination; provided only, that he pays the regular fees that are required from members in the Province in which he desires to practise.

5. That the suggestion be made to the general Council that the minimum rates of pay for engineers in the various Provinces be determined by a Commission composed of one member of the Provincial Cabinet, one member of the Provincial University, and one member of *The Engineering Institute* to be appointed by the general Council.

The intense interest which has been aroused shows clearly that there is a feeling on the part of the average engineer in Canada that something should be done, and soon. It is evident that there never was a more opportune time for the engineering profession to come into its own than at the present moment. Both during the present war and for a long period thereafter the engineer must play a very prominent part and it is natural that he should assume the position in which the importance of the work he is doing, in a national manner, would be recognized.

Whatever the form any legislation that is to be sought, may take, it must be founded on the basic principle, that, in securing the elevation of the profession, who are members of *The Institute*, no attempt should or will be made to insert any clause or clauses, either designed to force engineers to join the Institute or to interfere in any way with the rights of qualified engineers, who are non-members other than to give them the benefits that they as qualified engineers may gain by any legislation which may be effected, dealing with the interests of engineers in general.

Henry Ford and Production

Whatever may be the general idea concerning Henry Ford's abilities to discuss general problems, no one will deny the fact that he is one of the greatest masters of production, living. Consequently his opinion on industrial problems is worthy of every attention and respect. In an article in the September issue of "World's Work" in which he deals with the subject of production in a broad manner in its relation to benefitting humanity, he deals with two matters that are of unusual interest to the engineer, namely: standardization and the utilization of water power. Regarding standardization he says: "I don't care what the commodity is, if it is something that has a wide enough possible market it can pay high wages and give short hours and still sell the best quality of goods at the lowest possible price if its production is properly organized. The whole secret is to make one thing in one plant, concentrate every effort on that one standardized product, and adapt the machinery for its manufacture to automatic operation at the highest practicable speed. By educating the machine instead of the worker, it is possible to use untrained or practically untrained labor and pay it high wages, and still perform mechanical operations that formerly baffled even the most highly skilled worker. It is this sort of productive industry that I am going to link up closely to the farm, to demonstrate the final stage of what I believe to be the solution of the problem of living. Manufacturing instead of being concentrated in a few centres should be and can be widely distributed."

His opinion of the position which available water power occupies in relation to future industry should attract no small attention in Canada where we have the greater available undeveloped water power supply in the world. In this connection he states "There is enough water power running to waste to turn every wheel in the world and provide all the light and heat the whole world needs." (In connection with heat, as far as Canada is concerned, the engineering profession will not agree). "We are going to operate our Mexican tractor plant with water power and we shall build water power plants in several places in the United States. We must develop water power because it is not only more economical than steam power but we ought to save the rest of the world's coal supply for chemical use."

Government Commission Composed Entirely of Engineers.

During the past summer, the New Brunswick government appointed a commission to investigate the water power situation in that province. The appointment of such a commission is of course not unusual and would not warrant special notice except for the fact that this Commission contrary to the usual custom in appointing various government commissions consists entirely of engineers. C. O. Foss, Chairman of the Commission, has been connected with the Canadian Society of Civil Engineers and *The Engineering Institute* for a great many years. He is chief engineer of the St. John and Quebec Railway. B. M. Hill, a member of the Commission, is Provincial Engineer. Mr. Hill is an engineer who has taken considerable interest in public affairs and at one time contested a seat in the local Legislature. W. E. McMullen, Secretary of the Commission, is the engineer of the Crown Lands Department.

This Commission is acting in co-operation with the Dominion Water Power Branch so that the technical aspects of the water power situation in both the provinces of Nova Scotia and New Brunswick is being handled by a single engineering organization which results in maximum efficiency and economy. Although the New Brunswick Water Power Commission was not in a position to begin active operations until early in August last, already eleven stream measurement stations have been established in various parts of the province and an adequate foundation laid for obtaining basic stream-flow data in various parts of the province.

* * *

Capt. Percy W. Freeman, son of Phil A. Freeman, M.E.I.C., of Halifax, has been wounded by a bullet going through the calf of his leg, about three inches from the knee. He received this wound at the great Canadian charge of August 8th when "going over the top." Capt. Freeman carried right on in charge of his company and it was the following day ere his wound was dressed. The wire from Ottawa to his father read, "Wounded but still on duty." This is the third time Capt. Freeman has been wounded and gassed once. Capt. Freeman's brother, Lieut. H. G. Freeman, being sick with Spanish influenza, returned home to Halifax, discharged. Lieut. Freeman has now recovered and is applying to be re-appointed to go overseas, which we expect will be granted. Applications for admission into *The Institute* have been received from both of these gentlemen.

Report of Council Meeting

The regular monthly meeting of the Council was held at headquarters on Tuesday, October 22nd at 8.15 p.m.

After the reading of the minutes of the previous meeting which were confirmed, the report of the executive committee, which held two meetings since the last meeting of council, was presented.

Changes in the By-Laws: It was recommended that the report of the committee on changes in the by-laws be considered. This report was submitted by Professor Brown who pointed out the suggested changes, clause by clause, all of which were discussed at some length. Certain suggestions were made by council and the report was referred back to the committee asking that an amended draft be submitted to the next meeting of the council.

Provincial Legislation: As this is a subject of the greatest moment at the present time it has received considerable attention and discussion at previous meetings, which was continued at this meeting. The secretary was instructed to secure a copy of the latest draft proposed by the Saskatchewan branch for the purpose of publishing it in the November issue of *The Journal* and to advise all branches to send in their views and also those of individual members in order that they also be published in *The Journal,* it being the opinion of council that all discussion on this subject by the members should be confined to exchange of correspondence between the branches and through the columns of *The Journal.*

Registration of the Journal: Owing to the fact that the post office department had not yet granted statutory privileges for sending *The Journal* through the mails at the regular newspaper rate, which, it was understood, was due to representations made by interested parties, the Secretary was instructed to advise the post office department that the proposed changes in the by-laws are designed to make it clear that the subscription price of *The Journal* is three dollars a year to all members.

Associates of the Institute: A suggestion that a concerted effort be made by all branches to secure as associates of *The Institute,* men occupying prominent positions in affairs in Canada was heartily endorsed.

Educational Congress: The Secretary was instructed to write the Canadian National Congress on Education in Citizenship Through the Schools advising that council has no authority to allocate funds of *The Institute* for such a purpose as was requested in letter from their Secretary.

Hamilton Branch By-Laws: The suggested by-laws of the Hamilton branch were presented and it was decided to hold these until the report of the Montreal Branch, who in co-operation with the legislation committee of the council, are drafting a model set of branch by-laws was received. The secretary was instructed to write the Hamilton branch asking that the by-laws be not adopted until they were further advised.

Western Committees on Concrete: The nominations of the Manitoba, Saskatchewan and Calgary Branches, appointed for the purpose of carrying on investigations on the action of alkali salts on concrete, were approved as follows: Manitoba branch: B. S. McKenzie, W. G. Chase, W. P. Brereton and J. C. Holden; Saskatchewan branch, J. R. C. Macredie, E. A. Martin, H. McI. Weir and R. J. Leckie; Calgary branch,Geo. W. Craig, F. W. Alexander, H. Sidenius and A. S. Dawson.

Engineering Index: The courteous letter from the editor of the American Society of Mechanical Engineers regarding the continued use of the engineering index was read, in which it was requested that we continue to accept the service of the engineering index subject to financial arrangements being concluded later. The Secretary was instructed to write thanking the American Society of Mechanical Engineers for their friendly co-operation in this connection.

Change in Examinations: A recommendation from a meeting of the Board of Examiners and Education held on Friday, October 18th to the effect "that two papers be set on the examination in schedule "C" — one on the basic ideas of the subject and the other on applications — and that when writing on the second paper the candidate be allowed the use of his reference books" was approved.

Committee on Friendly Relations: A letter to the President from the Secretary of the American Society of Mechanical Engineers suggesting that the A.S.M.E. be included in the scope of the activity of *The Institute's* committee on friendly relations was presented by Mr. Vaughan. The suggestion was heartily approved and President Vaughan's name was added to those of the committee.

Letters: A number of letters were noted, including one from Secretary of the Toronto Branch regarding the formation of an Ontario Provincial division, one from the Manitoba Branch in reference to the next professional meeting, one from H. R. Safford, expressing appreciation of the Council's recent action and one from the Toronto Branch regarding work being done by the Hydro-Electric Power Commission of Ontario, a copy of which was ordered to be sent to the Secretary of the Saskatchewan Branch.

Classifications: Classifications were made for a ballot returnable November 19th.

Elections and Transfers: A ballot was canvassed and the following elections and transfers effected:—

Members

Percy Edward Hart, Toronto, Ont., since 1913 managing engineer with the Toronto Hydro-Electric system in charge of all engineering matters relating to construction, operation and design. David Walker Hays, Medicine Hat, Alberta, general manager and chief engineer Canada Land & Irrigation Company, Alberta. Theodore Kipp Jr., Winnipeg, Man., general superintendent and engineer Ogilvie Flour Mills Company Limited. Aubrey Granger Robb, Amherst, N.S., superintendent and chief engineer Robb Engineering Works Limited. Sir Charles Ross, Bart., Balnagown Castle, Rosshire, Scotland, for the past 21 years connected with the Ross Rifle Company, dealing with engineering and organizing work in connection with the production of rifles and cartridges, including design of machine tools

and layout of plant. At present confidentially conferring with American government on organization of war industry and acting as intermediary between the Government and the American Society of Mechanical Engineers. William L. Waters, E.E., M.E., C.E., (London) New York, N.Y., engaged in consulting engineering in private practice on railway and power work in Montreal, New York, Chicago and San Francisco. James Henry Winfield, Halifax, N.S., formerly president of the Nova Scotia Society of Engineers, general manager of the Maritime Telegraph & Telephone Company, Limited, The Telephone Company of Prince Edward Island and Consolidated Telephone Limited.

Associate Members

Major Harry Westropp Armstrong, of Deseronto, Ont., on active service 1915-1918, seventeen months with the Canadian Machine Gun Corps and eighteen months Canadian Railway Troops. Before going overseas Major Armstrong was engineer of bridges Toronto-Hamilton Highway Commission, at present resident engineer Imperial Munitions Board. Edward Fleming Bateman, Saskatoon, Sask., engaged on the erection of the structural steel and bunkers at new power house, reconstruction of pumping station, Saskatoon. John Edmund Belliveau, Halifax, N.S., assistant to chief engineer of the Provincial Highway Board of Nova Scotia. Reginald Cecil Frank Chown, Regina, Sask., construction engineer Saskatchewan Government Telephones. George Victor Davies, Quebec, P.Q., assistant engineer St. Lawrence Bridge Company, Quebec. Allan Hatch DeWolf, Cranbrook, B.C., city engineer of Cranbrook and general engineering and contracting. Ove Jensen Hein, Montreal, Que., formerly chief draughtsman and assistant works manager St. Lawrence Bridge Company and at the present time member of firm Hein-Crombie Company, Montreal. Robert Torrance Grant Jack, Toronto, Ont., since 1912 resident engineer on sewer construction, City of Toronto. Walter Edward Joyce, Montreal, Que., engineer of design Mount Royal Tunnel and Terminal Company Limited. Ernest Charles William Lemarque, Anyox, B.C., assistant engineer and surveyor Granby Mining Smelting & Power Company. Gordon Scovil Macdonald, St. John, N.B., since 1914 district engineer, Department Marine & Fisheries. William Duncan Mackenzie, Winnipeg, Man., division engineer Greater Winnipeg Water District. Major Reginald Walker McColough, third division officer R.C.E., Halifax. Frank Peden, B.A.Sc., Montreal West, Que., formerly member of firm Peden & McLaren, at present designing, supervising and surveying for the Steel Company of Canada in connection with their Montreal plants. Robert Rome, Vancouver, B.C., resident engineer Vancouver and District Joint Sewerage and Drainage Board. John Frederick Rowlands, Kelowna, B.C., for two years with the Canadian Expeditionary Force, at present field engineer in the Lands Department, Water Rights Branch, British Columbia Government. Frederick Rolls Smith, Calgary, Alberta, vocational advisor, Invalided Soldiers' Commission, Calgary, Alberta. John Albert Wakefield, Winnipeg, Man., engineer on survey and construction water mains, sewers, bridges, etc., engineering department, City of Winnipeg. Douglas Wyand, Ottawa, Ont., acting superintendent, gauge laboratory, Imperial Ministry of Munitions.

Juniors

Gordon David Calvert, Toronto, Ont., engineer for Canadian Stewart Company Limited on Toronto harbor improvements in charge of engineering portion of work for contractors. W. B. Crossing, at present somewhere in France with the Canadian Expeditionary Force, leaving Manitoba University to enlist, before attending which, he was transitman on C. P. R. survey. Reginald James McKenzie, Deacon, Manitoba, office engineer Greater Winnipeg Water District. Sydney Clarence Mifflen, B.Sc., Wabana, Nfld., engineer with Dominion Iron & Steel Company. John Hilyard Tabor Morrison, B.Sc., Wabana Nfld., with the Nova Scotia Steel & Coal Company, Wabana, Nfld. Frank O'Brien Meighen, B.Ss., Montreal, Que., chief of field party Mount Royal Tunnel. Wallace Wyniard Smith, Halifax, N.S., topographical surveying and secondary triangulation, Geological Survey.

Transferred from Associate Member to Member

Archibald Burnett, P.Sc., Swansea, Arizona, general superintendent Swansea Lease Inc. Norman Pearson Dalziel, Ottawa, Ont., chief inspector Imperial Ministry of Munitions. J. Reginald Freeman, Halifax, N.S., senior assistant engineer Department of Public Works, Canada. Roger DeLand French, B.Sc., Montreal, Que., partner Arthur Surveyor & Company, consulting engineer and mechanical engineer Lignite Utilization Board.

Transferred from Associate to Member

Alfred Stansfield, D.Sc., Montreal, Que., Birks Professor of Metallurgy, McGill University, has made extensive investigations concerning electric smelting of iron and zinc, electric reduction of magnesium, electric steel and ferro-molybdenum, and a member of the Dominion Government Commission which reported on the copper and zinc possibilities in Canada for the Minister of Militia & Defence.

Transferred from Junior to Associate Member

Joseph Adelard Bernier, B.Sc., Montreal, Que., superintendent of sewer construction, City of Montreal. Otis Stanley Cox, Halifax, N.S., assistant engineer, Public Works Department. Sydney George Dawson, B.Sc., Ottawa, Ont., at present district hydrometric engineer Department of the Interior, Calgary. Joseph F. Fredette, Merritton, Ont., with P. J. McGarry on survey plans and computations. Hyman A. Goldman, Toronto, Ont., assistant engineer, Toronto Harbor Commissioners. William Turnbull Jamieson, The Pas, Manitoba, division and office engineer, Hudson Bay Railway. Joseph C. H. Jette, B.A.Sc., Three Rivers, Que., in charge of construction of sewers and irrigation work Public Work Department. Leslie Evans Kendall, B.Sc., New Glasgow, N.S., inspector of shell components, Imperial Ministry of Munitions. Archibald Wilfrid Lamont, B.A.Sc.,

Winnipeg, Man., sales engineer and in temporary charge Canadian Westinghouse Company, Limited, Winnipeg office. Ernest J. T. Lavigne, B.A.Sc., Quebec, Que., assistant engineer Department of Public Works and Labor, Quebec. Albert Fraser Wall, Montreal, Que., superintendent of construction and maintenance for the Electric Commission of the City of Montreal. Roderick Bearce Young, B.A.Sc., Toronto, Ont., assistant laboratory engineer Hydro-Electric Power Commission.

Transferred from Student to Associate Member

George Hemmerick, B.Sc., Saskatoon, Sask., resident engineer for Murphy & Underwood, consulting engineers.

Transferred from Student to Junior

Joseph Marie Hector Cimon, B.A.Sc., Quebec, Que., in charge of surveys and general hydraulic work Price Brothers & Company Limited. Norman John Lake, Markdale, Ont., installing electrical apparatus for the Canadian Westinghouse Company Limited. Arthur H. Milne, B.Sc., Montreal West, Que., designing tools for marine engines, boilers, condensers and general machine shop work, Dominion Bridge Company Limited. Arthur Melville Snider, B.A.Sc., Sherbrooke, Que., schedule engineer in charge of production work of two foundries, Canadian Ingersoll-Rand Co., Ltd. Richard Lawrence Weldon, B.Sc., Montreal, Que., at present pursuing post graduate course and engaged as demonstrator in the Department of Mechanical Engineering, McGill University.

Member of Economic Board

Colonel J. S. Dennis, C.M.G., M.E.I.C., who has just completed his strenuous labors with the British Recruiting Mission has received further recognition of his ability in being appointed by the Dominion government as liaison officer of the Canadian Siberian Expedition. In this capacity Col. Dennis is one of an economic commission of four appointed by the Federal government, consisting of himself and C. F. Just, chief Canadian trade commissioner in Russia, W. D. Wilgress, Canadian trade commissioner at Vladivostok, and Ross Owen, transportation officer in Russia of the Canadian Pacific railway company. The two last are already in Siberia and Col. Dennis and Mr. Just are leaving at once for Vladisvostok.

The order-in-council naming the commission, states that its members will be expected to make a careful study of local conditions in Siberia, both economical and social; to inquire into transportation facilities; to ascertain the wants of the farming community in respect to agricultural implements and equipment, and to note the possible improvements in methods of handling grain, and in mining, forestry and fishing operations.

The commission is also instructed to investigate the opportunities, present and prospective, for increasing commercial interchange between Russia and Canada and to make recommendations as to the particular lines along which Canadian experience and industry might best lead to the rehabilitation of Russia's business activities and the development of her vast natural resources.

The Government is of the opinion that similarity of natural conditions between Siberia and Western Canada, as well as the problems connected with agriculture and transportation, mining and fisheries, are factors which enable Canada to co-operate under present conditions in the supply of the commodities urgently required, and also from experience and adaptability to afford practical assistance by advice and reconstruction along the lines particularly vital to Siberian reconstruction.

It is also recognized that Canada's interest in trade with Russia is undoubted. Besides assisting in the protection and pacification of Russia by means of the Canadian force now being mobilized, it is proposed, in conjunction with other countries, to reorganize her financial and commercial activities which have been thrown into confusion by a long period of war and internal disorder. The British Government has appointed a commercial commission to work in conjunction with the British high commissioner in Vladivostok, and has intimated its willingness to attach a representative of Canada to its staff.

A. G. DALZELL, A.M.E.I.C.

Secretary-Treasurer, Vancouver Branch.

CORRESPONDENCE

Sailor Engineer's Experience

Editor, *Journal,*

It is a great pleasure to me to receive *The Journal* so regularly and to be able to keep in touch with the profession at home by reading the reports of the work performed by our members.

Since I left Canada on August 31st, 1916, I have been stationed at all the different naval bases, including Gibraltar. My first ship was one of the largest and fastest ships in the Grand Fleet and for a time carried a vice admiral. Then I was appointed to superintend the building of four special ships known as Decoy Ships. I went to sea in the last of the four as chief engineer or as they name you in the service "engineer officer." My experiences in this class of ship were somewhat weird and doubtless you saw in the Star that the boat had been torpedoed, but I was safe. The only reason of my being safe was due to the fact that I had left the ship about eight hours before this happened and five officers were killed, including the engineer officer.

Then I had the delightful experience of returning to England through Spain and France. On reporting at the Admiralty I was appointed to the above destroyer and we are on distinctly interesting work. August 24th I was promoted to the rank of Engineer Lieut. Commander.

I take this opportunity of again thanking you for the kind thoughts expressed in your gift of tobacco which I received and enjoyed. Possibly my acknowledgement at the time did not reach you.

It will be good to get back to Canada and take up one's work again and I am longing for the day but at the same time, like many more who have come over, determined to remain until Fritz is completely washed out. Our friends across the border are pouring into this country and somewhat relieving the man-power problem.

These are bright days and we feel quite optimistic about returning home at the end of the spring next year.

With kind regards to yourself and the best of good wishes to the E.I.C.

Yours faithfully,

CHAS. STEPHEN, A.M.E.I.C.

H.M.S. Skate,
G.P.O., London,
15. 9. 18.

Datum Plane Table

Editor *Journal,*

In 1914, the B. C. Branch of the Canadian Society of Civil Engineers appointed a Committee to consider the establishment of a Standard Datum Plane for British Columbia, and I was appointed Secretary of the Committee.

We found at that time that the Mean Sea Level had not been determined by the Department of the Naval Service nor had the Department of the Interior completed the Precise Levelling between Vancouver and Blaine, Washington, and their Bench Marks were not available.

BRITISH COLUMBIA MAINLAND.
DATUM PLANES.

DATUM PLANES REFERRED TO VANCOUVER HARBOUR TIDE LEVELS.	O·L·W PLUS FEET	O·L·W MINUS FEET	M·S·L PLUS FEET	M·S·L MINUS FEET	H·W·L PLUS FEET	H·W·L MINUS FEET
ADMIRALTY DATUM. O.L.W.	ZERO			8·03		13·00
MEAN SEA LEVEL. M.S.L.	8·03		ZERO			4·97
HIGH WATER LEVEL. AVERAGE OF HIGHER HIGH WATER.	13·00		4·97		ZERO	
DATUM OF CAN. PAC. RLY. CO.		84·77		92·80		97·77
DATUM, CITY OF VANCOUVER.		83·52		91·55		96·52
DATUM, CITY OF NEW WESTMINSTER.	16·75		8·72		3·75	
DATUM, P.W. DEPT. FRASER RIVER.		0·70		8·73		13·70

COMPILED IN THE CITY ENGINEERS OFFICE. VANCOUVER A.G. Dalzell ASSISTANT CITY ENGINEER 1918.

After much correspondence between many Government Departments and the engineers of various railway Companies, I have been able to compile the accompanying correlation of Datum planes in use on the Mainland of British Columbia, and they serve to show how much better it would be if the Government would adopt a Standard Datum Plane to which all levels could be referred, corresponding to the Ordnance Datum of Great Britain.

The publication of the table will be of benefit to engineers in British Columbia, and the matter of establishing a standard Datum Plane in each province or for the whole Dominion is one that might well be considered by all branches of the Institute.

Yours faithfully,

A. G. DALZELL, A.M.E.I.C.

Secretary, Vancouver Branch.

Vancouver, Aug. 26, 1918.

MESSAGES FROM COUNCILLORS

Major D. A. Ross, Councillor, E.I.C.

"I trust that the newly formed *Engineering Institute* will take a worth place among the factors which are contributing to the upbuilding of our Dominion, and will assume a vigourous policy with a view towards maintaining the high standard that exists in our profession, and insisting on the recognition of our members by all public bodies.

The publication of *The Journal* is a step forward in the right direction, and I am confident that it will

MAJOR D. A. ROSS,
Councillor, E.I.C.

result in a free interchange of ideas and achievements between the various provincial branches that will have a far-reaching effect on the whole profession in this country."

* * *

Professor H. E. T. Haultain, Vice-President, E.I.C.

How can we "enhance the usefulness of the profession to the public?"

The engineer is probably the greatest undiscovered asset possessed by Canada. The nation needs his intangible, his man-qualities, even more than it needs his works. But the Nation does not know this.

How will this asset be discovered to the nation and developed?

We do not know; but this much we know, the first steps must come from the Engineer.

Progress will be by the methods of prospecting or research rather than by the accurate foresight that precedes the erection of an important structure.

How can we enhance the usefulness of the profession to the public?

In research, the attitude of mind counts more perhap than anything else, hence;

If we all ask the question and keep on asking it, in season and out, the true answers (they will be many) will appear.

* * *

PROFESSOR ERNEST BROWN,
Councillor, E.I.C.

Prof. E. Brown, Counciller, E.I.C.

Much has been said and written in recent years about the necessity of improving the status of the engineer. Legislation adequate to ensure that those not qualified as engineers are prevented from practising as such, and the strengthening of our own professional organization would help towards the end in view. A proper esprit de corps will however only result from the action of the individual, and from his attitude towards the profession. The cover of this journal bears a statement of ideals which may well serve as a motto for the membership, and each of us can help in strengthening the general professional position by living up to those ideals, and increasing our knowledge of the activities of *The Institute* and its membership through the pages of *The Journal.*"

BRANCH NEWS

St. John Branch

A. R. Crookshank, M.E.I.C., Secy.-Treas.

A splendid example of co-operation between a branch and the civic officials is afforded by the St. John branch in its latest meeting held on Monday evening, October 7th, when the branch members were the guests of the Board of Trade at which Alex. Gray, M.E.I.C., chairman of the branch read his paper on St. John harbor. It was intended to have C. C. Kirby, A.M.E.I.C., read the paper he presented at the professional meeting at Halifax but owing to illness he was unable to be present. The chairman of the Board of Trade, A. H. Wetmore, occupied the chair; both he and Mayor Hayes spoke of their enjoyable visit to the Halifax meeting and expressed their appreciation of the hospitality shown them.

After the reading of the paper on the St. John harbor a lengthy discussion took place by members of the Board of Trade and of the St. John branch. W. F. Hatheway wanted to know if the extension of the breakwater to Partridge Island would increase the current in the harbor, and Mr. Gray said he did not think it would. F. A. Dykeman asked what the cost of the extension would be, and was told between $750,000 and $1,000,000. Mr. Hatheway asked what about the building of a breakwater from the Island extending toward Red Head. Mr. Gray thought he would want to wait a year or so after the closing of the gap before doing this. G. N. Hatfield, A.M.E.I.C., asked if the closing of the gap would not make it more difficult to dock at No. 3 and 4 berths. Mr. Gray thought it would be easier to dock at these berths.

Dr. James Manning asked Mr. Gray's opinion of a scheme to build breakwaters below the Island and include all the water from Partridge Island inward in the harbor. Mr. Gray thought this was too big a job to tackle just now. The proposed extension on the west side provided for fifteen more berths and these would handle all the trade offering for many years.

A. R. Dufresne, M.E.I.C., favored the extension of the breakwater to the Island. He was inclined to think the scheme proposed by Dr. Manning an expensive proposition. Speaking of the dry dock Mr. Dufresne said it would be one of the largest in the world and would be built so that two ships could be repaired at one time. One of 650 feet and one of 500 feet in length. In answer to a question he said the work had to be completed in four years.

G. N. Hatfield thought the spur should be built from Partridge Island. Mr. Wetmore asked C. O. Foss, M.E.I.C., if he could say when the Valley Railway would be completed, who in reply said he was willing to pay for that information. The contractors were offering fifty cents an hour and at that could not get men. It was hoped to operate the road this fall and that was as far as he could go. He pointed out that with the completion of the Valley Railway there was a double track from the West to St. John by way of the N.T.R. via McGivney Junction, the other being the C.P.R.

From McGivney Junction to St. John was 117 miles; from McGivney to Moncton was 97 miles, and from Moncton to Halifax was 200 miles more and this saving in distance should result in the larger part of the traffic coming to St. John. To double track the I. C. R. from Moncton to Halifax and provide a low grade would cost at least $24,000,000.

J. A. Likely asked Mr. Foss where the N. T. R. and C. N. R. were to ship their goods if they came to St. John, and how they would reach the west side.

To this Mr. Foss replied that Mr. Gray had shown where fifteen additional berths could be provided and this would care for it all. The Valley Railway was to be linked up with the C. P. R. at Westfield and this provided the means of entry. He hoped the time would come when St. John would need berths in Courtenay Bay, but until such times as the west side was all built up there was no need of spending money for berths there.

Mr. Gray pointed out to Mr. Likely that when the harbor went into commission no railway would control the tracks to the wharves, but they would be equally free to all.

Before closing the meeting, President Wetmore extended the thanks of the Board to Mr. Gray for his excellent paper.

Montreal Branch

Frederick B. Brown. M.E.I.C., Secy.-Treas.

The activities of the Montreal Branch have been curtailed owing to the influenza epidemic. The Executive Committee has been meeting regularly and a great deal of committee work has been accomplished. Reply post cards were sent out to the membership of the branch and as result about two hundred and seventy-five replies were received from the members giving information which has been of considerable assistance to the committee in classifying the membership and in enabling the committee to make arrangements to notify all those members who are specially interested in the various sections. R. M. Hannaford, the chairman of the Papers and Meetings Committee, has classified all these replies and has inaugurated a system of telephone teams whereby his committee can quickly reach every member of the branch in case of necessity. This promises to be of great service in creating greater interest in all the activities of the Branch.

The Executive decided, in view of the importance of the proposed legislation now being considered by some of the western branches, that one or more meetings of the Montreal Branch in the early autumn should be devoted to the question of legislation. It was accordingly arranged that the first meeting of the branch should be called for Thursday, October 10th, to discuss legislation matters, but the orders of the Board of Health cancelling all gatherings have prevented the meeting from taking place. Meanwhile, considerable correspondence has been received by the Branch Secretary indicating a very keen interest in the subject and as soon as the *Institute* is permitted to meet it is proposed to open the season's proceedings with this discussion on legislation. The Secretary would be much pleased to have written discussions submitted by any member of the Branch.

Halifax Branch

K. H. Smith, A.M.E.I.C., Secy.-Treas.

At a meeting of the Executive Committee on October 7th, a program of meetings for the approaching winter was discussed. A motion was made and carried that regular meetings of the Branch be held on the evenings of the second Thursday of each month from October to April, inclusive. The Papers Committee which made such satisfactory arrangements for the professional meeting of *The Institute* recently held in Halifax and consisted of Capt. J. L. Allan, J. W. Roland and A. J. Barnes, was requested to continued in office until the close of the present year, that is, during the life of the present Executive Committee which is temporary. This Committee is to secure papers for the regular meetings.

Unfortunately the influenza epidemic has made it necessary to hold all arrangements for meetings in abeyance and it was not possible to hold an October meeting.

It is expected to hold the regular meetings of the Branch in the Board of Trade rooms which were found so satisfactory for such purposes during the recent professional meeting. The Branch is greatly indebted to the local Board of Trade for its assistance in every possible way.

Naturally since the recent professional meeting there has seemed to be a more than usual lull in the activities of the Branch. However, comments are still being heard as to the success of this meeting and the benefits which are likely to accrue not only from this meeting but from similiar meetings in the future at which engineers from all parts of the maritime provinces rather than from any particular section may meet and discuss their problems. It was evident at the last meeting that great benefit may arise from a free and frank discussion particularly by engineers, of certain problems concerning which in the past there has been seeming conflict between various sections of the maritime provinces.

Comments are also being made on the advantages accruing to *The Engineering Institute of Canada* as a national body, to local engineers and to the engineering profession as a whole from the recent amalgamation of the Nova Scotia Society of Engineers with *The Institute*. It has been pointed out that under the old conditions it would hardly have been possible to hold such a meeting as was recently held in Halifax at which there were representatives from all parts of eastern Canada and a number of places in the United States.

The local Branch has not yet had an opportunity of discussing the question of legislation dealing with the status of engineers. It is thought however, that the general impression is that some such legislation is desirable providing it can be worked out on a uniform basis throughout all parts of the country and in all fairness to everyone concerned. At the same time there is a feeling that perhaps legislation should be considered more in the nature of the means to an end than an end in itself. If permanent results are to be obtained and the engineering profession put on a proper footing, engineers themselves both individually and collectively must take a more active part in public affairs generally and demonstrate their value to a community. Of course, the problem of obtaining legislation gives an opportunity for the proper kind of publicity along these lines and in any case unless public opinion is sufficiently aroused, legislation will either fail to pass or not be effective.

Vancouver Branch

A. G. Dalzell, A.M.E.I.C., Secy.-Treas.

At a meeting of the Vancouver Branch of *The Engineering Institute of Canada*, held in October, a total of 53 members was reported as having enlisted in military or naval service. *The Institute* is endeavouring to keep in touch with these members as far as possible, and has in past years sent Christmas greetings and gifts to those whose addresses were known. So many, however, of the members are officers and are constantly being moved to different fronts, that it is very difficult to keep the list posted to date. Any who know the present addresses of the members overseas will confer a favour by informing the Secretary, A. G. Dalzell, 612 Board of Trade Building, Vancouver, B.C.

The following members have laid down their lives for King and country: Lieut. D. P. Bell-Irving, Major J. A. Delancey, M.C., Lieut. W. L. Frame, M. L. Gordon, Lieut. H. E. R. Hamilton, 2nd Lieut. W. P. Unwin, Major R. H. Winslow.

Prisoner of war in Germany: Major J. R. Grant, M.C.

Members believed to be overseas: C. F. Alston, Lieut. J. W. B. Blackman, Lieut.-Col. H. L. Bodwell D.S.O., C.M.G., Major C.R. Crysdale, Lieut. J. F. Cahan, Major J. R. Cosgrove, M.C., Lieut. P. E. Doncaster, C. G. DuCane, H. F. Dyke, E. A. Earl, 2nd Lieut. W. S. Ford, Capt. W. A. E. Grim, J. C. Glanville, Lieut. N. M. Hall, Sergt. J. B. Holdcroft, J. Hammer-Schou, Capt. A. E. Humphrey, D. A. Livingston, Col. F. E. Leach, C. S. Manchester, Lieut. C. MacDonald, Lieut. T. Muirhead, S. S. McDiarmid, Sub. Lt. F. O. Mills, Lieut.-Col. W. H. Moodie, D.S.O., Lieut. H. M. Morrow, Lieut. K. W. Morton, Lieut. A. W. McKnight, J. R. Middleton, Capt. J. H. Parks, L. F. Pearce, Major K. M. Perry, D.S.O., J. M. Rolston, Lieut. A. K. Robertson, Lieut. H. B. Sims, Major W. G. Swan, Lieut.-Col. G. A. Walken, Lieut. R. Snodgrass.

In the American Service: Capt. A. C. Eddy, American Army, C. Lee, American Navy.

Members who have returned to Canada: Brig. General R. G. E. Leckie, C.M.G., Lieut.-Col. H. St. J. Montizambert, Lieut.-Col. W. M. Davis, (died Oct. 1918), Major H. B. Earle, Lieut. C. W. Gamble.

Manitoba Branch

Geo. L. Guy, M.E.I.C., Secy.-Treas.

A special meeting of the Manitoba Branch was held in the engineering building, University of Manitoba, on Thursday, September 26th, at which twenty-two members attended. The particular reason of this special meeting was for the purpose of discussing the draft of the proposed Act for the engineering profession in Saskatchewan.

The resignation from the executive of J. C. Holden was received. To fill the vacancy Guy C. Dunn and M. C. Hendry were nominated, thus necessitating a ballot to the members of the Branch to secure election and the Secretary undertook to issue such a ballot immediately.

The matter of representation on the Concrete Committee to investigate the action of alkali salts on concrete as proposed at the Western professional meeting was then considered. Nominations were made and a vote taken resulting in the election to this committee of B. S. McKenzie, W. G. Chace, W. P. Brereton, J. C. Holden. The Secretary was instructed to convey to the Chairman of the Saskatchewan Branch the result of this election and impress upon him the urgency of having a personnel of the entire committee filled so that the committees could be ratified by Council and the work of investigation proceeded with.

Greater representation by the engineering profession on the Greater Winnipeg Board of Trade was then considered. The feeling of the meeting was that a section of engineers should be formed on this Board. The following signified their intention to become members of the Greater Winnipeg Board of Trade:— E. Brydone-Jack, T. L. Roberts, J. Rochetti, A. H. O'Reilly, J. C. Holden, Wm. Smaill, Geo. L. Guy; those already being members of the Board: Chas. F. Gray, T. R. Deacon, Col. Ruttan and John Woodman. It was resolved that the professional engineers ask for a section of their own in the Board of Trade and E. Brydone-Jack was appointed to get in members.

The balance of the meeting was devoted to a lengthy discussion on legislation in which the proposed Act for Saskatchewan was discussed clause by clause and a number of admendments made. A notable suggested change was that where the words Engineering Institute of Saskatchewan appear, there should be *Engineering Institute of Canada*, Saskatchewan Division. It was considered advisable to eliminate the clauses, Residence within Saskatchewan, Corporations and Joint Stock Companies, Advertising and Seal. It was decided to submit the suggested changes in the draft to the Saskatchewan Branch as embodying the present views of the Manitoba Branch on the subject.

The meeting adjourned at 12:30.

Saskatchewan Branch

J. N. deStein, M.E.I.C., Secy.-Treas.

The question of legislation is the all-absorbing question in the Saskatchewan Branch at the present time. Two meetings were held in September and two in October at which the draft bill, submitted in tentative form to the western professional meeting, has been discussed clause by clause. When the bill was originally brought out it was admitted to be far from complete and a long way from what it was expected would be adopted. The branch is eager to have the Act brought to such a form that it will be acceptable to the branches in other provinces and act to some extent as a model for general provincial legislation. The suggestion of the Manitoba Branch will no doubt, be carried out that after the Western Branches have all thoroughly discussed and revised the proposed Act, a joint meeting of all the branch legislation committees be held for the purpose of finally revising it for submission to Council.

PERSONALS

E. G. Cameron, A.M.E.I.C., is now living in St. John, having recently accepted a position as engineer for the St. John Dry Dock & Shipbuilding Company. Mr. Cameron was previously engaged on the Welland Ship Canal.

Secretary Crookshank of the St. John branch advises that F. L. Richardson, assistant engineer Department Public Works has been transferred from the Toronto office to St. John and has been placed in charge of the branch office on the Courtenay Bay work.

T. A. Jardine Forrester, M.E.I.C., who was a member of Council until 1917 and who spent two years overseas, is now in Australia and is acting as manager of the engineering department for Brown and Dureau, Ltd., Sydney, Australia. This firm represents the Dominion Bridge Co., Ltd., in Australia.

Claude V. Johnson, A.M.E.I.C., who has for some time past been chief engineer of Jos. Gosselin, Limited, Quebec, has accepted a position with the Foundation Company, Montreal, and will in future be connected with the Montreal office of that company, Bank of Ottawa Building.

Newton J. Ker, M.E.I.C., of Vancouver, has just received the well merited promotion of being appointed assistant executive agent in British Columbia for the Canadian Pacific Railway. Mr. Ker will continue to retain supervision of the Land Department, as heretofore, as engineer and agent for British Columbia. One of Mr. Ker's activities during recent years has been the development of Shaughnessy Heights in Vancouver, which is one of the finest residential sections of any city in Canada.

Reginald H. Thomson, M.E.I.C., formerly development engineer for the British Columbia government in designing and supervising the establishment of a magnificent park scheme for the government on Vancouver Island, and at present special engineer Washington Public Service Commission, Seattle, was in Montreal recently and called at headquarters. Mr. Thomson was greatly interested in the appearance of the new crest and was disappointed to hear that there had been some delay in connection with its adoption. He was assured that it was expected that when adopted the crest would be universally satisfactory.

Hugh Cameron, A.M.E.I.C., mechanical engineer, Canadian Northern Railway, was one of the party of officials of the railway who inaugurated the passenger service between Montreal, Ottawa and Toronto; the party consisted of S. J. Hungerford, general manager of Eastern lines, W. A. Kingsland, general superintendent, James Morrison, assistant passenger agent, Guy Tombs, assistant freight traffic manager, and others. The passenger service between Montreal and Toronto will consist of three trains each way daily, embodying the most modern equipment. From the Montreal station electric engine carries the cars to the tunnel and as far as Lazard whence a steam locomotive is employed.

OBITUARIES

Henry Edward Randall, Jr., J.E.I.C.

In the death of Harry Edward Randall, Jr., which occurred at Montreal, on Monday, October 21st, of Influenza, *The Institute* loses one of its most promising younger members. The late Mr. Randall was born at Island Pond, Vermont, March 28, 1893; was graduated from the Massachusetts Institute of Technology in 1913 and entered the Institute as a Junior member, October 30, 1917.

Since graduating he was employed by the Shawinigan Water & Power Co., working at first on the Cedars Rapids Development, and afterwards engaged in various capacities in the Shawinigan Co's offices in Montreal. He ultimately reached the position of power sales en. gineer, and manager of the subsidiary electrical companies. On October 1, 1918, Mr. Randall severed his connection with the Shawinigan Water & Power Co. and entered the employ of the Ludlum Electric Furnace Corporation with the position of general manager. Mr. Randall was widely known in Montreal and throughout Eastern Canada. He took an active part in various engineering matters, and was actively interested in the Canadian Electrical Association. His untimely death is deeply regretted by his associates in the Shawinigan Company, and his many friends in Montreal and elsewhere. Personally a man of attractive qualities he possessed energy and ability and had he lived would have had a future of great promise.

Lt. Col. William Mahlon Davis, M.E.I.C.

When the war broke out William Mahlon Davis was engaged in engineering work at the Coast and immediately interested himself in military affairs, going overseas later as Lieut. Colonel of the 54th Kootenay Battalion which has since distinguished itself on many occasions, but owing to an accident, he did not see active service. His death at Ottawa on October 17th removes one of the original members of *The Institute*, as he was elected to associate membership February 24, 1887, having graduated from the Royal Military College, Kingston, seven years previously. On April 9th 1891 his election to full membership was effected at which time he was engaged as city engineer of Woodstock, Ont.

Francis Joseph Cronk, M.Sc., A.M.E.I.C.

The influenza epidemic in Montreal, from which he suffered, accompanied by an attack of pneumonia was responsible for the death of Francis Joseph Cronk at the Western hospital, Montreal, on Saturday, October 12th after a week's illness. The late Mr. Cronk started his engineering experience as a chainman with the C. P. R. survey, Toronto to Sudbury branch, at the age of 17, in 1904 and for six years he advanced by various stages until in 1910 he was assistant superintendent with the Paterson Construction company, building the Esquimalt and Nanaimo railway, Vancouver Island. During the four years following he attended McGill University being employed during each of the summer periods as transitman for the Canadian Pacific Railway on western lines. He was graduated with the degree of B.Sc. in 1914 and later secured the degree of M.Sc.

The unusual talents and the splendid practical experience which he had had were recognized by McGill University in his appointment to the staff as assistant professor of railway engineering. In January 1915 the late Mr. Cronk was elected to junior membership and transferred to associate membership June 1917. He was a native of Montreal, being 31 years of age at the time of his death, and leaves a wife and infant son. His loss will be felt particularly in university and engineering circles.

Major Rainsford-Hannay Winslow, B.Sc., M.E.I.C.

News of the death of Major R. H. Winslow, officer commanding the first tramways company, Canadian engineers, who was killed on September 9, 1918, was sorrowfully received by those in Canada who knew him and had an opportunity of appreciating his many excellent qualities. He was born in Fredericton, N.B., in 1887, the youngest son of the late Edward Byron Winslow, K.C., was graduated from McGill University in 1909, entered *The Institute* as a junior April 1913, transferred to associate membership June 1914 and became a member, January 29th of this year.

At the time of his death he had seen three years of active service, having gone overseas as lieutenant with the 48th battalion in the spring of 1915, being promoted to captain on the field and within the present year attained the rank of major. On December 22, 1917 he was married in London, to Miss Doris McLagan, daughter of Mrs. J. P. McLagan of Vancouver and is survived by his wife, two sisters, Mrs. G. D. Ireland of Vancouver and Mrs. E. R. duDomaine at present in England, four brothers, Wentworth B. Winslow, New York, J. J. Fraser Winslow, K.C., Fredericton, N.B., F. E. Winslow, Victoria, B.C., Capt. R. M. Winslow, 310th Engineers American Expeditionary Force, another brother, Capt. J. A. Winslow of the Canadian Ammunition Column died in France last year.

The late Major Winslow was an active member of the McGill Alumnae Association of British Columbia and a popular member of the University Club. Previous to enlisting for overseas he was chief engineer to the Vancouver Harbor Commissioners, having resided at the coast since 1910.

Albert Bromley-Smith. A.M.E.I.C.

The late Albert Bromley-Smith, A.M.E.I.C., died at the Royal Victoria Hospital, Montreal, on Sunday, October 20th., 1918.

He was born at East Dulwich, London, Eng., on September 12th, 1880 and was educated at the Finsbury Technical College and the Central Technical College, London.

Coming to Canada thirteen years ago, he joined the engineering staff of the Canadian Pacific Railway Company and with the exception of a short time spent in the Cobalt, was with the Company until he died. His engineering ability and aptitude for mathematics brought him steady promotion and at the time of his demise he was Assistant Engineer, and devoted a large part of his time on switch and maintenance of way work.

He was greatly interested in the activities of the Last Post Fund, filling the position of Honorary Assistant Secretary. To commemorate the death of a younger brother, dying in the service of his King and Country in Palestine, Mr. Bromley-Smith donated a flag pole to the Last Post Fund, which was erected among the graves of a number of our returned soldiers and sailors two months ago, under military and naval auspices. He now lies under the shadow of the flag in the plot of ground consecrated to the cause of the Last Post Fund.

The Chief Engineer of the C. P. R. and his staff attended the funeral service at the grave side in Mount Royal Cemetery.

The many floral tributes testified the respect and affection in which the late Mr. Bromley-Smith was held by the friends he had left behind.

SITUATIONS VACANT

Draftsman.

Draftsman for railway office in New Brunswick. A young man who is willing to work his way upwards. Apply Box No. 11.

Instrumentman.

At once, competent instrumentman wanted for Canadian Government Rlys. Apply Box No. 12.

Instrumentman.

An experienced instrumentman wanted, preferably a young university graduate, for the Engineering Department of a railway company in Quebec Province. Address Box No. 15.

Draftsmen.

Several mechanical draftsmen required for Steel Corporation. Apply Box No. 16.

Testing Expert.

Wanted by Ordnance Department of United States Government, mechanical engineer familiar with micrometer and heat testing methods to be employed in Canada. young college graduate preferred. Address Box No. 17,

Transitman.

For temporary work with railway office, experienced transitman for Montreal and vicinity. Address Box 18.

Timber Scaler.

A timber scaler for the New Westminster Timber agency, Department of the Interior, at a salary of $2,000 per annum. Candidates must hold a scaler's license from the British Columbia government and must have had experience in the measurement of timber. Address: Civil Service Commission, William Foran, Secretary, Ottawa.

Assistant Mining Engineer.

An assistant mining engineer in the Ore Dressing and Metallurgical Division of the Mines Branch, Department of mines, Subdivision A of the Second Division, initial salary $1,800 per annum. Candidates must be graduates in mining engineering of a recognized University, and must have had, since graduation, actual experience in the commercial milling of metallic ores. Applications of those who can show evidence of initiative will receive special consideration. Address, Civil Service Commission of Canada, Ottawa. Wm. Foran, Secretary.

Hydrometric Engineer.

An engineer on the staff of the Manitoba Hydrometric Survey in the Department of the Interior, at an initial salary of $125 per month. Candidates should be graduates in engineering of some Canadian or British University and should have had at least one year's field experience in practical engineering or survey work. Candidates should not be more than 35 years of age. Preference will be given to returned soldiers. Address, Civil Service Commission of Canada, Ottawa. Wm. Foran, Secretary.

Preliminary Notice of Application for Admission and for Transfer

1st November, 1918.

The By-Laws now provide that the Council of the Society shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to Secretary any facts which may affect the classification and election of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described on 26th November, 1918.

FRASER S. KEITH, Secretary.

*The professional requirements are as follows:—

Every candidate for election as MEMBER must be at least thirty years of age, and must have been engaged in some branch of engineering for at least twelve years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in some school of engineering recognized by the Council. The term of twelve years may, at the discretion of the Council, be reduced to ten years in the case of a candidate who has graduated in an engineering course. In every case the candidate must have had responsible charge of work for at least five years, and this not merely as a skilled workman, but as an engineer qualified to design and direct engineering works.

Every candidate for election as an ASSOCIATE MEMBER must be at least twenty-five years of age, and must have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineers' office, or a term of instruction in some school of engineering recognized by the Council. In every case the candidate must have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years.

Every candidate who is not a graduate of some school of engineering recognized by the Council, shall be required to pass an examination before a Board of Examiners appointed by the Council, on the theory and practice of engineering, and especially in one of the following branches at his option Railway, Municipal, Hydraulic, Mechanical, Mining, or Electrical Engineering.

This examination may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five years or more years.

Every candidate for election as JUNIOR shall be at least twenty-one years of age, and must have been engaged in some branch of engineering for at least four years. This period may be reduced to one year, at the discretion of the Council, if the candidate is a graduate of some school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-five years.

Every candidate who is not a graduate of some school of engineering recognized by the Council, or has not passed the examinations of the first year in such a course, shall be required to pass an examination in the following subjects Geography, History (that of Canada in particular), Arithmetic, Geometry Euclid (Books I.-IV. and VI.), Trigonometry, Algebra up to and including quadratic equations.

Every candidate for election as ASSOCIATE shall be one who by his pursuits, scientific acquirements, or practical experience is qualified to co-operate with engineers in the advancement of professional knowledge.

> The fact that candidates give the names of certain members as references does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

BATTERSHILL—JOHN WORTHY, Jr., of East Kildonan, Man. Born at Birmingham, England, June 18th, 1885. Educ. Public & high schools, math. & mech. drawing in I. C. S., and private tuition. With Vulcan Iron Works as apprentice at patternmaking 5½ yrs., 6 mos. in foundry, 6 mos. millwright dept. and 6 mos. steel framing. With engr. dept. city of Winnipeg, 1906-08, mech. draftsman, 1908-14 (excepting 6 mos. in 1910) asst. ch. draftsman, designing buildings, sewers, waterworks, etc., 6 mos. 1910 asst. engr. Manitoba Government Elevator Comn., in chg. of repair and constr.; 1914 to date municipal engr. for rural municipality of East Kildonan, Man.

References: W. P. Brereton, W. G. Chace, W. Aldridge, G. L. Guy, H. N. Ruttan.

BERNEY—KENNETH CARLING, of Hamilton, Ont. Born at Athens, Ont., Sept. 15th, 1885. Educ. B.Sc., Queen's Univ. 1906; summer 1903, with J. H. Moore, O.L.S., Smith's Falls, Ont.; with Canadian Westinghouse Co. as follows: 1906-7, engineering apprenticeship course; 1907-8, sales engr., Montreal office; 1908-9, installed gasoline engines and lighting plant for Gould, Shapley & Muir Co., Brantford, Ont.; 1909 to date, electrical engr. for Canadian Westinghouse Co., Hamilton.

References: H. U. Hart, H. B. Dwight, E. R. Gray, E. H. Darling, J. Taylor, W. Arch. Duff.

CAMPBELL—ANGUS DANIEL, of Cobalt, Ont. Born at Stayner, Ont., Mar. 19th 1887. Educ. B.A.Sc. and M.E., Univ. of Toronto; summers 1907-8, office man, rodman and inspector, Trent Canal constrn.; 1909, mine surveyor, O'Brien Mine, Cobalt; summer 1910, engr. for Dominion Nickel Copper Co., Sudbury; 1911 to date, mining engr., O'Brien Mine, Cobalt, Ont. (Member Can. Mining Institute and Temiskaming Mine Managers Assoc'n.)

References: J. G. Dickenson, H. E. T. Haultain, P. Gillespie, G. Hogarth, R. W. Leonard, W. J. Francis.

CAMPBELL—THOMAS BUCHANAN, of the Pas, Man. Born at Glasgow, Scotland, 8th Jan., 1868. Educ. Glasgow & West of Scotland Tech. College, 1884-89 apprentice to Robertson & Laird, Civil Engrs., Glasgow, 1889-91 asst. engr. with same firm, 1891-1901 asst. engr. with ch. engr. Caledonian Ry., Glasgow, 1901-1905 private practice, consulting engr., Glasgow, on railway and harbour work, 1905-12 res. engr., div. engr. and bridge engr. with MacKenzie, Mann & Co., 1912-13 principal asst. engr. on preliminary harbour works, Port Nelson for Dept. of Rys. & Canals, 1913 to date div. engr. and bridge engr., Hudson Bay Ry. for Dept. Rys. & Canals.

References: N. P. Dalziel, E. W Oliver, J. W. Porter, W. C, Thomson R. A. Hazlewood.

COSSER—WALTER FRANCIS JOHN, of Schumacher, Ont. Born at Maidenhead, Eng., April 20th, 1873. Educ. Winchester Coll. and Kings Coll. School, London; 1891-4, apprenticeship with Easton, Anderson & Goolden of Erith & London; 1894-6, asst. on erection of transmission plant at Barberton, Transvaal, S. Africa; 1896-99, in chg. of generating station for Moodies Co., Barberton; 1900-5, electrician in chg. of plant, Tebekwe Gold Mines Co., Selukwe, S. Rhodesia; 1905-6, working electrician, Lancaster Gold Mine Co., Kongersdorp, S.A.; 1906-7, electrician in chg., Treasury Gold Mine Co.; 1907-13, electrician in chg., Cinderella Consolidated Gold Mines, Boksburg, Transvaal, S.A.; 1914-17, in chg. of plant, Dome Mines, S. Porcupine, Ont.; Feb. 1918 to date, mech. supt. in chg. of plant, McIntyre Porcupine Mines, Schumacher, Ont.

References: H. P. dePencier, J. C. Gwillim, B. L. Thorne, F. A. Bell, D. E. Keeley.

ELLISON—CHARLES HENRY, of Firdale, Man. Born at Port Stanley, Ont., 23rd Aug., 1884. Educ. Public School and private study in math. and tech. subjects. With G. T. P. Ry. as follows: 1904-5 (9 mos.) rodman, topographer and leveller, 1906-8 rodman and instrumentman on constr., 1909 (9 mos.) instrumentman, 1910 Jan. to Apr. transitman, Apr. to June res. engr. Battleford branch, June to Feb. 1911, asst. engr. in chg. of location Cut Knife branch, 1911 Apr. to Aug. asst. engr. in chg. of surveys, Aug. to Nov. constr. Brandon branch, 1912-1913 asst. engr. in chg. of constr. Prince Albert branch, 1913-14 locating engr., main line, E. D. & B. C. Ry. With A. & G. W. Ry. engr. in chg. of constr. May, 1914-Dec. 1915 and Mar. 1917-Dec. 1917. At the present time asst. engr. in chg. of constr. G. T. P. Ry., main line revision at Firdale, Man.

References: J. A. Heaman, G. C. Dunn, W. R. V. Smith, J. G. Legrand, H. E. Berg.

GARNEAU—JEAN BERCHMANS, of Quebec, Que. Born at Quebec, Oct. 29th, 1890. Educ. Bachelor of Surveying, Laval Univ. 1912; 1911, in chg. of sounding party on St. Charles River; 1911, engaged in railroad constrn., Quebec & Saguenay Railway; 1912, asst. engr., St. Charles River Works; 1913, in chg. of constrn. party on Montreal-Quebec Highway; 1914 to date, in chg. of laboratory, Dept. of Roads of the Prov. of Quebec.

References: J. A. Lefebvre A. Tremblay, A. B. Normandin, G. Henry, R. Savary, A. Fraser.

HARRIS—HARVEY WILFRED, of Winnipeg, Man. Born at Kingston, Jamaica, B.W.I., Oct. 29th, 1886. Educ. B.Sc. McGill Univ. 1916; 1910-11, transitman, C.P.Ry.; with N.T.Ry. as follows: 1911-12, inst'man; 1912-14, res. eng. in chg. of constrn., District "E"; 1914-15, res. engr., District "D"; 1916, (3 mos.), engr. for Foundation Co., on contract at Sault Ste. Marie, Ont.; 1916 to date, engr. for Thos. Kelly & Sons, general contractors, Winnipeg, Man.

References: W. G. Chace, J. W. Astley, J. Armstrong, W. J. Dick, A. V. Redmond, G. McL. Pitts, G. A. Mayne.

HOLLAND—HENRY DONALD, of Montreal. Born at Leamington, Eng., Jan. 22nd, 1893. Educ. B.Sc., McGill Univ. 1914; 1911, asst. on Geological, Topographical and Magnetic surveying, Dept. of Mines; 1913, (6 mos.), in chg. of small power unit, C.N.R Tunnel, Montreal; 1914-15, Inst'man for G.P. Howley at Cedar Rapids Power Plant; 1915-17, dftsman for Electrical Commission; 1917-18, asst. city engr. and engr. of works, City of Verdun; at the present time, supt. of constrn. for M. J. Stack, contractor.

References: R. S. Kelsch, L. A. Herdt, J. DeG. Beaubien, R. H. Balfour, H. M. MacKay, G. Reakes.

JEFFREY—GEORGE JAMES, of Vancouver, B.C. Born at Ruthvenfield, Pertshire, Scotland, Aug. 2nd, 1882. Passed complete Civil Engineering Course at the Glasgow & West of Scotland Technical College, 1902-10, summer and evening sessions. 1897-1902 apprenticed 4 yrs. and retained 1 yr. as asst. engr. by Henry Bruce, A.M.I.C.E., Cupar Fife, Scotland, 1902-10 in charge of office and outside staff of D. V. Wyllie, I.A., surveyor and architect, Glasgow, 1910 to date ch. dftsman and engr. in chg. of office of T. H. White, ch. engr. C. N. P. Ry., Vancouver, B.C., and responsible for all plans and estimates.

References: T. H. White, D. O. Lewis, H. A. Dixon, S. H. Sykes, H. L. Johnston, W. K. Gwyer, C. Brakenridge.

JONES—WILLIAM GOLDSMITH, of North Vancouver, B.C. Born at London, England, 11th May 1877. Educ. Tudor Hall Coll., Kent, England, Philological School London & London Polytechnic. Pupil with late Wm. Goldsmith, A.R.I.B.A. & F.S.I., 1894-99, 1899-02 South African war, 1902-05 with Messrs. Mansfield & Sons, London, England, engrs. & contractors, measurements & estimates, 1906-07, with Messrs. Hill & Reynolds, mining engrs. Bulawayo Rhodesia laying out & erecting gold mining plant, stamp batteries, conservation of water supply, etc., 1909-12 (2½ yrs.) with B. C. Elec. Ry., instrumentman on location & constr. of car lines, 1912 city engr's staff, Vancouver, engr. in chg. of paving car tracks, 1913 engr. for McAlpine, Robertson Constr. Co., laying out & erecting 6 stall round house, turn table, etc., at Penticton, B. C. for K. Y. Ry., 1914 city engr's. staff, Vancouver, inspector on street paving contracts, 1915-June 1916 asst. engr. Vancouver dist. Joint Sewerage Drainage Board, under A. D. Creer, general instrument work, 1916-18 overseas C.F.A., at present representative Imperial Munitions Board at Wallace Shipyard, N. Vancouver, during installing of engines, boilers, etc., in H. M. T. War Cayuse & H. M. T. War Atlin.

References: A. D. Creer, Donald Cameron, Patrick Phillip, A. G. Dalzell, C. Brakenridge, A. K. Robertson.

KER—FREDERICK INNES, of Montreal. Born at Dunham, Que., Oct. 25th, 1885. Educ. B.Sc., McGill Univ. 1909; 1908, (4 mos.), with maintenance of way dept., G.T.R.; 1909-11, with Toronto Construction Co. on constrn. of Transcontinental Ry. in New Brunswick; 1911-12, with C.P.Ry. on Georgian Bay & Seabord Line; 1912, (5 mos.), supt. of constrn. with same firm; 1912 to date, chief engr. and genl. supt., Cook Construction Co., Montreal.

References: H. M. MacKay, W. F. Tye, W. J. Francis, J. M. R. Fairbairn, H. O. Keay, C. W. P. Ramsey.

KERR—ALBERT ERNEST, of Hamilton, Ont. Born at Hamilton, Ont., Mar. 11th, 1892. Educ. B.A.Sc., Toronto Univ. 1913; switchboard dftsman, Canadian Westinghouse Co., Hamilton; in complete chg. of electrical drafting at Steel Co. of Canada; at the present time, electrical dftsman, same concern.

References: H. B. Dwight, H. U. Hart, E. R. Gray, W. E. Janney, E. H. Darling.

LEVVY—ALBERT, of Winnipeg, Man. Born at Nottingham, England, 2nd Mar., 1883. Educ. Associate, Nottingham Univ., 1902, Technical Schools, Nottingham, student, motor design J. Blackburns & Sons, Nottingham and Underground Cables, Leeds Corporation, England, asst. motor testing Ampere Electrical Mfg. Co., Ltd., Montreal, Que., 1911 to date managing director, The Levvy Electrical Co., Ltd., Winnipeg, Man., electrical and motor maintenance contractors.

References: G. L. Guy, John Woodman, Wm. G. Chace, E. V. Caton, J. M. Leamy.

LEWIS—DONALD, of New Glasgow, N.S. Born at Glace Bay, N.S., Oct. 27th, 1891. Educ. public schools and private technical training; 1905-6, clerk, freight dept., Sydney & Lanisburg Ry.; with Dominion Coal Co., Glace Bay, N.S., as follows:—1906-7, dftsman; 1907-10, mechanical dftsman; 1910-11, ch. dftsman and asst. constrn. engr., Lethbridge Collieries Ltd., Lethbridge, Alta.; 1911-12 mechanical and structural dftsman, Dominion Bridge Co.; 1912, dftsman, Algoma Central & Hudson Bay Ry., Sault Ste. Marie, Ont.; 1912-13, ch. dftsman and asst. constrn. engr., Pacific Pass Coal Fields Ltd., Edmonton, Alta; 1913-14, mechanical dftsman, Canadian Copper Co., Copper Cliff, Ont.; 1914-15, asst. mechanical supt., Intercolonial Coal Mining Co., Westville, N.S.; with Nova Scotia Steel & Coal Co. as follows: 1915-17, designer and dftsman; 1917 to date, chief dftsman.

References: W. G. Matheson, C. Fergie, C. M. Odell, R. E. Chambers, J. S. Whyte, R. B. Stewart, G. H. Duggan.

MARKHAM—EDWIN, of Regina, Sask. Born at Grimsby, England, July 26th, 1883. Educ. B.C.E. with honors Univ. of Manitoba, 1914. Passed final exam. D.L.S., May 1918. With Phillips, Stewart & Lee of Saskatoon as follows, dftsman 6 mos. in 1911, transitman in chg. of party 6 mos. of 1912 and 1913 on subdivisions, surveys, etc., transitman P. W. D. of Canada on Sask. River survey, 6 mos. in 1914, asst. to Stewart Young, Dist. Surveyor, Highways Dept., Sask. 6 mos. in 1916 and 1917, locating and surveying highways. At present asst. to Stewart Young.

References: E. H. Phillips, E. Brydone-Jack, H. S. Carpenter, Stewart Young, W. M. Stewart, E. W. Murray.

McLAREN — WILLIAM FREDERICK, of Hamilton, Ont. Born at Hamilton, Ont., May 31st, 1871. Educ. M.E., Cornell Univ. 1894; 2 yrs. R.M.C., Kingston; 1890, helper in repair shops of Hamilton St. Ry. & Toronto Elec. Light Co.; 1894, worked on test of power plant, Hamilton St. Ry.; 1895, inspector, Westinghouse Elec. & Mfg. Co., East Pittsburgh; 1897, on installation of electrical apparatus for Hamilton Cataract Power Co., DeCew Falls; 1900, shift engr., W. Kootenay Power Co., Bonnington Falls, B.C.; 1901-5, mech. dftsman, Westinghouse Elec. & Mfg. Co.; 1905 to date, ch. dftsman, Can. Westinghouse Co., Hamilton, Ont. (1916-17 on active service, Capt. 164th Bn., C.E.F.)

References: H. U. Hart, H. B. Dwight, R. A. Ross, H.B. Muckleston, A. L. Mudge, W. A. Bucke.

MacPHERSON—ARCHIBALD ROSS, of Hamilton, Ont. Born at Toronto, Ont., June 6th, 1888. Educ. B.A.Sc., Univ. of Toronto, 1913; 1905-7, worked for Father in office and outside work; 1908, drafting and surveying, for C. A. Jones, Petrolia; 1909 to date, with P. H. Secord & Sons, as supt. and manager, on building construction, etc.

References: E. R. Gray, E. H. Darling, J. Taylor, W. E. Janney, F. W. Paulin, J. Erskine.

MOODIE,—WALTER TAYLOR, of Winnipeg, Man. Born at Glasgow, Scotland, Mar. 10th, 1882. Educ. Glasgow & W. of Scotland Tech. Coll.; 1898-1902, apprenticeship; 1902-3, asst. engr. with engineering firm; 1903-4, asst. engr., Caledonian Ry.; with Central South African Rys. as follows:—1905, (7 mos), asst. engr. on location; 1905-6, res. engr.; 1907-8, locating engr., with C. N. Ry. as follows:—1908-11, asst. engr.; 1911-15, engr., maintenance of way; 1915-17, division engr.; Jan. 1918 to date, district engr.

References: M. H. MacLeod, J. C. Holden, T. W. White, J. G. Legrand, W. Burns, W. Walkden.

MORSE—EMERSON HIBBERT, of Norwood, Winnipeg, Man. Born at Bridgetown, N.S., 14th June, 1886. Educ. Hants Collegiate Acad., Windsor, N.S. With G. N. Ry. 1906 rodman, 1907-08 instrumentman & material clerk, 1908-09 instrumentman on Crow's Nest Southern Ry. & on mine survey of Crow's Nest Pass Coal Co., at Fernie, B.C., 1909 instrumentman on Wash. & G. N. Ry. at Behuld, Wash., 1910 fence inspector C.N.Ry. & draftsman G.T.P. Ry. With G.T.P. Ry. as follows: 1911 topographer & transitman, branch lines, & res. engr. Cut Knife br. 1912-13 res. engr. Brandon br. 1914-15 in chg. roudhouse constr. Smithers, B.C., 1915 inspector water supply at Smithers, B.C. 1916 to date draftsman with G.T.P. Ry. at Winnipeg, Man.

References: J. A. Heaman, J. G. Legrand, G. C. Dunn, H. E. Berg, P. E. Thian, W. H. Tobey.

NEWTON—CHRISTOPHER ANTHONY, of Magnolia, Maryland. Born at Wardley, Eng., April 21st, 1877. Educ. 3 yrs., Univ. of Calif.; certificate Mine Surveyor of Transvaal, S.A., 1908; 1908-9, asst. surveyor, Durban Deep Gold Mining Co., Transvaal; with C.N.Ry. as follows: 1913-14,dftsman; 1915, inst-man; 1915-17, res. engr.; with Foundation Co. as follows: 1917-18, ch. of party, constrn. of International Nickel Co's plant, Port Colborne, Ont.; 1918, res. engr., constrn. of water works for U. S. Govt. chlcrine plant, Edgewood Arsenal, Maryland; at the present time, progress engr.

References: A. F. Stewart, H. K. Wicksteed, E. V. Johnson, C. V. Johnson, C. H. N. Connell, E. P. Johnson.

PETERS—JOSEPH DUFFERIN, of Moose Jaw, Sask. Born at Perth Co., Ont., Apr. 18th, 1884. Educ. Collegiate Institute, home study, night classes in steam, elec. and mech. engr. First class stationary engr's certificate for Sask., 3 yrs. boiler attendant with the Thames Dairy Co., London, Ont., 2 yrs. stationary engr. in 200 H.P. steam plant, Canadian Milk Products, Brownsville, Ont., 2 yrs. plant operator and electrician Barkey Bros. Elec. Plant, Tillsonburg, 1 yr. in chg. of 2-500 H.P. generating units, London Elec. Co., 6 mos. installing and operating steam elec. plant for Moore Milling & Elec. Co., Qu'Appelle, Sask., 9 mos. asst. ch. engr., City Power Plant, Moose Jaw, Sask., 9½ yrs. and at present time supt. Light & Power Dept., Moose Jaw, Sask.

References: G. D. Mackie, W. H. Greene, J. N. deStein, F. S. Keith, A. H. Dion.

PINDER-MOSS—JOHN FREDERICK SAMUEL, of Edmonton, Alta. Born at Leicester, England, Oct. 11th, 1882. Educ. Honours in Bldg., Constrn and Architecture, Nottingham Univ. 1902; Post Grad. work N.Y. Univ. 1914; 1898-1902, articled pupil to Joseph Perkins, Architect and Surveyor, Leeds, Eng.; 1902-8, Crew Electric Ry. & Plant, England; new village of Shirebrook Main, including streets, houses, stores, club, water & sewage works and Pit Shaft Head, Shirebrook, Eng.; demolition work (slums) and new thoroughfares at Nottingham, Eng., for the Rt. Hon. Earl Manvers; 1908-12, member of firm, Moss & Brown; 1912-14, managing dftsman, Barratt, Blackadder & Webster, Edmonton & Barnes & Gibbs, Edmonton; 1914 to date, head of department, Architectural & Mechanical Drawing, Technical High School, Edmonton; during school holidays, 1917-18, with Dept. of Railways & Canals, Edmonton, and G.T.P.Ry., Edmonton.

References: A. T. Fraser, G. C. Dunn, R. Cunningham, A. W. Haddow, L. B. Elliot, G. H. Ferguson, N. M. Thornton, D. J. Carter.

ROBINSON—ROY CLIFTON, of Saskatoon, Sask. Born at Brandon, Man., Aug. 21st, 1884. Educ. diploma Univ. of Toronto; worked on surveys in minor capacity for C.P.Ry. and C.N.Ry.; 1909-10, asst. to W. H. Waddell, D. L. S.; 1910-11, inst'man, G.T.P.; 1911-16, engr. in chg. on trestle bridges and concrete substructures, C.N.Ry.; 1918, asst. engr., Manitoba Hydrometric Survey, Winnipeg; June 1918 to date, res. engr., C.N.Ry., Saskatoon, Sask.

References: M. C. Hendry, C. P. Richards, A. W. Smith, T. W. White, C. Landon.

ROXBURGH—GERALD STEELE, of Winnipeg, Man. Born at Norwood, Ont., May 4th, 1884. Educ. B.A.Sc., Toronto Univ. 1905; with Fetherstonhaugh & Co. as follows: 1 yr. in Toronto & Ottawa offices; 1905 to date, Western manager, in full charge of Winnipeg office.

References: G. L. Guy, T. L. Roberts, D. T. Main, J. A. Douglas, E. E. Brydone-Jack, W. P. Brereton, G. R. Pratt.

FOR TRANSFER FROM THE CLASS OF ASSOCIATE MEMBER TO THAT OF MEMBER

CARSON—WILLIAM HARVEY, of Ottawa, Ont. Born at Stirling, Scotland, June 27th, 1877. Educ. C. E., Glasgow Royal Tech. Coll.; 1905, passed exam. for A. M. Inst. C. E.; 1910, passed exam. for entrance to Civil Service, Ch. Engr's office; 1893-94, pupil with Short & Fairful, Stirling; 1894-7, articled pupil with consulting firm, Kirkcaldy; 1897-1907, asst. to City Engineer, Glasgow; 1907-10, asst. to N. J. Ker, Dept. of Roads & Sewers, Ottawa; 1910-11, asst. to Lt.-Col. W. P. Anderson, Dept. of Marine, Ottawa; 1911-12, res. engr. on constrn. The Parisienne lighthouse & fog alarm station; 1912-13, engr. in chg. of constrn. for Province of Ontario; 1913 to date, dist. engr. for Prov. of Ontario, Dept. of Marine, Ottawa.

References: W. P. Anderson, H. B. R. Craig, B. H. Fraser, A. Gray, J. Haddin, N. J. Ker, R. H. Parsons, J. B. McRae.

DOYLE—DAVID, of London, Eng. Born at Birkenhead, Eng., Mar. 8th, 1873. Educ. Wesleyan School, Birkenhead, and privately; 1894-6, Liverpool School of Technology; 1896-8, Holt School of Science; 1889-94, pupil with Thos. Turner & Son, London; 1898-1900, asst. engr. and dftsman, Loughborough Corporation Waterworks, Leicestershire; 1900-3, asst. engr., Lake & Currie, London; 1903-5, asst. engr., Hardie & Co., Valparaiso, Chili; 1905-6, engr. in chg. of constrn., Agna Santa Ry. & Nitrate Co., Caleta Buena, Chili; 1906-7, engr. for Ralston & Summers on contract for Lime Electric Railways, Chosica, Peru; 1907, (6 mos.), engr. on railway and bridgework for Southern Ry. of Peru Ld., Lima, Peru; 1908-10, engr. Bolivian Govt., South America under direction of J. Pierce Hope; 1910-12, engr. with Smith, Kerry & Chace, Vancouver, B.C. & Portland, Ore.; 1912-14, asst. ch. engr. with Great Northern Ry. under Jas. H. Kennedy, Vancouver, B.C.; 1914-16, private practice in Vancouver; 1916-18, engr. in chg. of design and constrn., Munition Works, England, for Ministry of Munitions of War; Feb. 1918 to date, asst. supt., Building Works Dept., Royal Arsenal, Woolwich, Eng.

References: W. P. Brereton, J. H. Kennedy, H. K. Dutcher, C. H. Topp, T. White, H. E. C. Carry, D. Cameron.

HARVIE—EBEN NASMYTH, of Cambridge, England. Born at Bellshill, Scotland, 3rd July, 1883. Educ. Tech. Classes and Certificate Royal Tech. Coll., Glasgow, Scotland. 1898-1905 apprentice and asst. Mccoll & Findlay, Glasgow. 1905-07 asst. Syson & Midgeley, A.M.I.C.E., Glasgow, 1907-08 draftsman and instrumentman, G. T. P. Ry., Winnipeg and northern B. C., 1909-11 municipal engr. S. Vancouver and constr. engr. Burnaby, B.C., 1912-14 engr. and surveyor, Vancouver school trustees, 1915-17 (6 mos.) engr. in chg. of railway constr., site 3, H. M. factory, Gretna, Scotland, 1917 (6 mos.) engr. in chg. of main line corrections and railway yards H. M. factory, Henbury, Bristol, England, 1917 to date, ch. asst. engr. in chg. of all railways, excavation work, washing plants, etc., Cambridge, Coprolite Workings, Ministry of Munitions.

References: F. L. MacPherson, D. Cameron, E. A. Cleveland, H. M. Burwell, A. G. Dalzell, F. Silverton.

JOHNSON—CLAUDE VERNON, of Quebec, Que. Born at Ottawa, Ont., Mar. 16th, 1881. 1903-8, rodman, inst'man, dftsman, etc. with C.N.Ry., G.T.P.Ry and N.T.Ry.; 1908-13, asst. engr. and asst. office engr., N.T.Ry., Ottawa; 1911 to date, engr. in chg. of constrn. and engineering for Jos. Gosselin Ltd., General Contractors & Engineers.

References: St. G. Boswell, A. C. Fellows, A. Dick, W. D. Baillarge, A. F. Stewart.

LEAMY, JAMES MAURICE, of Winnipeg, Man. Born at Ottawa, Ont., Dec. 1st, 1875. Educ. Grad. St. Louis College, B.C., 1892; 1892-4, lectures, Ottawa Univ.; 1899-1900, engineering student, Westinghouse Electric Mfg. Co., Pittsburg; 1893-8, design & installation, hydraulic and electric work, Electric Railway location and equipment, Ottawa Electric Street Ry. Co. & Ottawa Electric Co.; 1898-99, in charge electrical equipment, Dept. of Public Works, Ottawa; 1906, asst. in chg. location and erection, high tension line constrn., West Kootenay Light & Power Co.; 1907, city electrical engr., Grand Forks, B.C.; 1908-9, asst. in chg., location survey, Hudson Bay Ry.; 1909-10, inspector of high tension line constrn., City of Winnipeg, hydro-electric constrn.; 1910-11, inspector of installation of electrical equipment, Point du Bois, Man.; 1912, engr., City Light & Power Dept., Winnipeg; 1914-17, Provincial Electrical Engr., Manitoba Government; 1918, member of Federal Lignite Commission.

References: J. G. Sullivan, E. V. Caton, R. A. Ross, J. Murphy, J. B. McRae, W. P. Brereton, H. A. Bowman.

MACKIE—GEORGE DOUGLAS, of Moose Jaw, Sask. Born at Perth, Scotland, Mar. 8th, 1878. Educ. Glasgow and West of Scotland Tech. Coll.; 1893-99, trained in Perth Municipal Offices; 1899-1900, asst. road surveyor, Roxburghshire, 1900-5, waterworks engr., Clydebank & District Water Trust; 1905-9, visited all filtration plants in England and France, in connection with reinforced concrete mains; 1912-14, city engr., Swift Current, Sask.; 1914 to date, City Commissioner, Moose Jaw, Sask.

References: L. A. Thornton, J. Haddin, T. A. Murray, W. J. Francis, N. J. deStein, F. H. Peters, E. L. Miles.

ROGERS—CLAUDE HENRY, of Peterboro, Ont. (On active service). Born at Peterboro, Ont., Jan. 17th, 1884. Educ. B.A.Sc., Toronto Univ. 1907; 1900-1, underground work, Cardora Mine; 1902, on constrn. of plant and power station, Spanish River Pulp & Paper Co.; 1903, field work, Canadian Niagara Power Co.; 1904, res. engr. on constrn. and bridge work; 1905, with T. & N. O. Ry. & Ontario Railway Commission; 1906, asst. engr. on maintenance and yard constrn., G. T. Ry.; 1907-8, in chg. of exploration party in Northern Ontario for private syndicate; with Peterboro Canoe Co. as follows: 1908-9, supt.; 1909-14, genl. mgr.; 1915 to date, field engr. in chg. of work of Forward Tramways, 1st Army, B.E.F., France.

References: E. L. Cousins, R. B. Rogers, W. Macphail, W. J. Francis, C. Mitchell, H. N. Ruttan.

WALLBERG—EMIL ANDREW, of Toronto, Ont. Born in Sweden, Jan. 27th, 1868. Educ. C. E. State Univ. of Iowa, 1891, one post graduate yr. Mass. Inst. Tech. Draftsman in bridge office, asst. engr. in chg. of shop & erection 4 yrs. ch. engr. Canadian Bridge & Iron Co., Montreal, Que. At present time engr. designer, builder & owner of hydro-electric & industrial plants.

References: M. J. Butler, H. Holgate, R. A. Ross, W. J. Francis, J. M. Robertson.

FOR TRANSFER FROM CLASS OF JUNIOR TO HIGHER GRADE

FORSYTH—JAMES, of Winnipeg, Man. Born at Stirling, Stirlingshire, Scot., May 6th, 1887. Educ., Saint Andrews Coll., Toronto, Ont., & Univ. of Man. With C. P. R. as follows: 1905 rodman in Man., 1906-07 topographer in Sask. & Alta., 1907-08 instrumentman in Ont. & Man., 1909 (7 mos.) fence inspector in Sask., 1909-10 topographer in B.C. on grade reduction & with exploration party under A. E. Sharpe, 1910-12 instrumentman with G. T. P. In Alta., maintenance of way under G. C. Dunn, 1912-14 res. engr. G. T. P. maintenance of way under G. C. Dunn at Watrous, Sask., 1915 to date asst. engr. P.W.D., Prov. Government, Man.

References: H. A. Bowman, F. A. W. MacLean, L. B. Copeland, R. W. McKinnon, G. H. Baird.

HOBBS—WILFRID ERNEST, of East Kildonan, Man. (On active service). Born at Brighton, Eng., Mar. 12th, 1887. Educ. Framlingham Coll., Suffolk and Municipal Tech. School, Brighton; Man. L.S.; D.L.S.; 1903-7, articled to A. F. Graves, surveyor and estate agent, Brighton; with C.P.R. as follows: 1907-8, on maintenance of way; 1908-9, on surveys; 1910-11, in chg. of survey parties in Manitoba, Saskatchewan, Alberta and Ontario; 1911-12, on surveys, roads, etc.; 1912-16, private practice, Bayne & Hobbs, Winnipeg; Feb. 1916, Lieut. C.E., asst. to Commanding Royal Canadian Engineer, Military Dist. 10; 1916-17, camp engr., Camp Hughes, in chg. of all engineering works (30,000 men); March 1917, transferred to Can. For. Corps to proceed overseas; 1917, (7 mos.), in full chg. of location and constrn. of camp, light railways, etc., England; June 1918 to date, Capt., No. 13 Coy. Can. For. Corps, B.E.F., France, (Aerodrome Constrn.)

References: W. S. Fetherstonhaugh, J. A. Hesketh, G. A. Bayne, D. A. Ross, F. Lee, J. C. Holden.

MAHON—HARRY WENDELL, of Great Village, N.S. (On active service.) Born at Great Village, N.S., April 26th, 1889. Educ. B.Sc., N.S. Tech. Coll.; with N. T. Ry. as follows: summers 1906-7, rodman; 1908-11, asst. engr., summer 1912, in St. John Office; summer 1913 with C.P.Ry.; 1914, (6 mos.), in chg. of concrete constrn., Nova Scotia Govt., Kings Co., N.S.; 1915-17, asst. engr., Water Power Branch, Dept. of Interior, Halifax; 1917 to date, [illegible] C.G.H.A. Headquarters, B.E.F., France.

References: K. H. Smith, N. E. D. Sheppard, A. J. Macdonald, H. Donkin, H. Longley, J. T. Johnston, C.O. Foss.

McEWEN—MAJOR ALAN BRETELL, M.C., of Montreal. Born at Byron, Ont., Jan. 23rd, 1891. Educ. B.Sc., McGill Univ. 1912; Grad. R.M.C., 1910; 1908, (3 mos.), town surveying and drainage work, London, Ont.; 1909, (3 mos.), survey, London to Brantford, for H.E.P.C. transmission line; 1911, (4 mos.), topographical survey of Petawawa Reserve; 1912-13, with R. S. Lea, on municipal works; 1913-14, design and constrn. of reinforced concrete dams with Ambursen Hydraulic Constrn. Co.; 1914-18 with C. E.F.; Feb. 1918 to date, principal asst. to R. S. & W. S. Lea, Consulting Engineers, Montreal.

References: R. S. Lea, W. S. Lea, R. D. French, H. G. Hunter, G. R. Heckle.

SCOTT—PETER, of Glasgow, Scotland. Born at Greenock, Scotland, 19th, Apr., 1883. Educ. Greenock Tech. School of Engr. (special engr. course) and Glasgow & West of Scotland Coll., 1904. 1901-04 student under Robt. Gilmour, Esq., A.M.I.C.E., engr. to the Corporation of Greenock, on constr. of reservoirs and gravitation filters for bridge of Weir and Ranfully, 1904-08 asst. engr. Water Dept. Corporation of Greenock in chg. of design and engr. in chg. of constr. of reservoirs, pipe lines, etc., 1908-12 with C. P. R. drawing office, constr. dept., 1912-14 asst. engr. C. P. R., eastern lines, on water supply, 1915-18 assst. inspector of munitions for Glasgow area, with supervision and entire chg. of all factories and output in Scotland under the British Government, 1918 to date, senior asst. inspector of munitions areas (Glasgow area) in sole chg. of cast iron shell work in Scotland & supervision of staff of 1,400 examiners.

References: J. M. R. Fairbairn, J. W. Orrock, James Ewing, J. R. W. Ambrose, A. Bromley-Smith, Robert McKillop, Frank Taylor.

SMITH—BRITON OLIVER, of London, Eng. Born at Montreal, Nov. 14th, 1888. Educ. B.Sc., McGill Univ. 1915; 1905-9, apprentice, C.P.Ry. and Hart Otis Car Co.; 1910, inspector, Hart Otis Car Co.; 1911-12, dftsman, Bath Iron Works; with Vickers Limited, Eng., as follows: 1915-17, marine engine dftsman; 1917 to date, mechanical engr.

References: E. Brown, A. Roberts, R. deL. French, G. H. Duggan, E. S. Holloway.

FOR TRANSFER FROM CLASS OF STUDENT TO HIGHER GRADE

CREASOR—JOHN ALFRED. (On active service.) Born at Owen Sound, Ont., May 23rd, 1893. Educ. B.Sc., McGill Univ., 1914; summer 1912, rodman, Government Survey; with Kennedy Bros., Montreal as follows: summer 1913, foreman; 1914. (8 mos.), asst. supt.; 1915, Lieut. 60th Bn.; 1917, promoted Capt.; 1918, pointed Staff Capt. 3rd Bde., C.E.

References: J. Kennedy, J. C. Kennedy, C. W. U. Chivers, R. W. Bishop, A. G. L. McNaughton.

HARKOM—JOHN FREDERICK, M.C., of Melbourne, Que. Born at Melbourne, Que., Oct. 6th, 1889. Educ. 4 yrs. Upper Canada Coll., Toronto, B.Sc. McGill. 1914. 1906-10 (4 yrs.) with Canada Foundry Co., shop & drawing office, Toronto, 1914 to date overseas, now Captain, Royal Field Artillery, B.E.F., France, commanding 57th Medium Trench Mortar Batteries, B.E.F., France.

References: J. W. Harkom, R. A. Ross, C. M. McKergow, H. W. Jones, F. S Keith.

HUNT—WALTER GEORGE, of Grand Mere, Que. Born at Bury, Que., 19th Apr., 1893. Educ. B.Sc., McGill Univ. 1917, and Stanstead Wesleyan College. July, 1917-Feb. 1918, with the Topographical Surveys Branch, Ottawa, technical clerk; 1918, (2 mos.), draftsman with Canadian DesMoines Steel Co., Chatham, Ont.; (3 mos.), hydrometric engr., Irrigation Branch, Calgary, Alta.; Aug. 1st to date, asst. engr. on surveys, drafting, construction, with Laurentide Co., Grand Mere.

References: H. M. MacKay, E. Brown, R. deL. French, P. M. Sauder, W. W Wotherspoon.

ROCHER—BARTHELEMY, of Quebec, Que. Born at Montreal, June 1st, 1893. Educ. C.E., B.A.Sc., Laval Univ. 1916; summers 1913, with City of Montreal, under Mr. A. Vincent; with Roads Dept. of Prov. of Quebec as follows: summers 1914-15, time-keeper and Inst'man; 1916-17, civil engr., 1917-18, assisting the engr. in chg. of maintenance of roads; March 1918, assisting the engr. in chg. of District No. 3.

References: A. R. Decary, A. Amos, G. Henry, A. Fraser, A. Lariviere.

ROLAND—JOSEPH OVILA, of Montreal. Born at Montreal, Nov. 19th, 1895. Educ. Civil and Chemist Engr., Laval Univ.; 1914, on survey, constrn. etc., with Dept. of Public Works; 1915, with Geological Survey; summers 1916-17, with "Material Road Survey," Geological Survey; at the present time, chemist analyst, Can. Explosives, Belœil, Que.

References: E. Marceau, A. Surveyer, J. A. Baulne, A. Frigon, F. C. Laberge, P. LeCointe, C. Leluau.

ENGINEERING INDEX

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AERONAUTICS

Aerostatics. Military Aerostatics, H. K. Black. Aerial Age, vol. 7, nos. 24,25, 26, Aug. 26, Sept. 2, Sept. 9, 1918, p. 1167, 1 fig., p. 1219, p. 1267, 1 fig., vol. 8, nos. 2 and 3, Sept. 23 and Sept. 30, 1918, p. 65, 1 fig., p. 119, 1 fig. Aug. 26: Science of ballooning; Cocquot type. Model *M*, operated by Royal Flying Corps Sept. 2: Parachute harnesses. Sept. 9: Dimensions of American observation balloons. Sept. 23: Construction of balloon winches. Sept. 30: Handling a balloon in the field.

Altitude. An Alignment Chart for Obtaining Heights from Observations of Pressure and Temperature, A. H. Stuart. Aerial Age, vol. 7, no. 26, Sept. 9, 1918, p. 1275. Constructed by solving Laplace's equation between height above datum level and pressure and temperature of atmosphere, by means of a d'Ocagne alignment chart.

Problems in Flying at High Altitudes, W. Kasperowicz (Translated from French by Augustus Post). Flying ,vol. 7, no. 8, Sept. 1918, pp. 714-715. Changes produced by reduced air pressure.

Bolts. On the Strength of Bolts in Airplane Structure, John Case. Aeronautics, vol. 15, no. 252, Aug. 14, 1918, pp. 134-139, 17 figs. Formulæ and rules for design; strength of bolts, in spars and the like, when subject to transverse loads at the ends; distribution of loads between bolts holding single plate under tension; distribution of load between bolts of joint subjected to bending. (To be continued.)

Enemy Aircraft Exhibit. The London Enemy Aircraft Exhibit. The Fokker Biplane, G. Douglas Wardrop. Aerial Age, vol. 8, nos. 2 and 3, Sept. 23 and 30, 1918, pp. 68 and 87, 1 fig. and p. 130, 1 fig. Sept. 23: Data of design of captured German machine of D VII type. Sept. 30: Holberstadt two-seater.

Engines. Aluminum Pistons for German Airplane Engines, C. Vickers. Brass World, vol. 14, no. 9, Sept. 1918, pp. 258, 1 fig. Drawing and description of aluminum piston taken from a 230-hp. Benz motor of captured Aviatik biplane.

Enemy Aircraft Engines (VIII). Automobile Engr., vol. 8, no. 116, July 1918, pp. 194-199, 11 figs. 180 hp. Mercedes: cylinders and other parts: lubrication; ignition; water-circulation system; power and consumption curves.

Modern Aeronautic Engines (II), Herbert Chase. Jl. Soc. Automotive Engrs., vol. 3, no. 3, Sept. 1918, pp. 205-208, 17 figs. Details of Sunbeam and Rolls-Royce (English) and Hall-Scott (Am.) engines. (Concluded from August issue.)

The Design of Aeroplane Engines, John Wallace. Aeronautics, vol. 15, nos. 251 and 252, Aug. 7 and 14, 1918, pp. 116-118, 7 figs., and 141-143, 6 figs. Aug. 7: Remarks on two-cylinder engines; twin-cylinder Vee engine; horizontally opposed twin; three-cylinder; four-cylinder vertical. Aug. 14: Three-cylinder radial engines; five-cylinder radial. Determination of results. (Continuation of serial.)

The 240 H.P. 8-cylinder Mercedes. Aerial Age, vol. 7, nos. 25 and 26 Sept. 3 and 9, 1918, pp. 1220-1221, 4 figs., pp. 1270-1274, 17 figs. Sept. 3, Detailed report on design of a captured German two-seater; summary of tests: cylinders; reduction gear. Sept. 9: Crank chamber; vertical driving gear; lubrication; water circulation; ware-pump test report; ignition; air pump; engine data; general analysis of weights of parts.

The 300 H.P. Maybach Aero-Engine. Engineering, vol. 106, no. 2748, Aug. 30, 1918, pp. 226-228, 17 figs. Detailed and illustrated description of the six-cylinder German engine. Also published in Engineer, vol. 126, no. 3270, Aug. 30, 1918, pp. 184-186, 7 figs., and in Flight, vol. 10, no. 36, Sept. 5, pp. 995-1000, 10 figs. Connecting rods; valve gear; cam diagram and valve timing; crankshaft. (Continuation of serial).

Individual Types. A Fokker Biplane of Recent Type. Flight, vol. 10, no. 30, July 25, 1918, pp. 829-831, 1 fig. Details of a captured German machine.

Some New Enemy Airplanes. Aviation, vol. 5, no. 4, Sept. 15, 1918, pp. 235-237, 9 figs. Dimensions and nature of Albatros D. 5, and of Fokker D. 7. Summary from L'Aérophile, L'Aéroplane, Flight and Flying. (To be continued.)

The D.H. 5 Pursuit Biplane. Aviation, vol. 5, no. 4, Sept. 15, 1918, pp. 228-229, 7 figs. Description of an English tractor biplane with a single pair of interplane struts on either side and with wings set at a negative stagger of 0.695 m. Also published in Aerial Age, vol. 8, no. 2, Sept. 23, 1918, pp. 70-71, 6 figs. Translated from Zeitschrift fur Flugtechnik und Motorluftschiffahrt.

The Hannoveraner Biplane. Flight, vol. 10, no. 36, Sept. 5, 1918, pp. 987-993, 28 figs. Details of construction of captured plane. Report of Technical Department, Aircraft Production, Ministry of Munitions.

The Pfalz Single-Seater Fighter — 160 H.P. Mercedes Engine. Flight, vol. 10, nos. 30, 31, 32, 33, July 25, Aug. 1, Aug. 8, Aug. 15, 1918, pp. 822-827, 5 figs., pp. 855-856, 3 figs., pp. 885-888, 7 figs., pp. 905-908, 5 figs. July 25: Official data; diagrams showing method of covering body with ply-wood; wing roots. Aug. 1: Mounting of the tail-plane root; details of runner. Aug. 8: Safety-belt attachment; control handle; undercarriage. Aug. 15: Wiring diagram; wing structure and arrangement. Also published in Automotive Ind., vol. 39, no. 10, Sept. 5, 1918, pp. 406-409, 7 figs.

Giant Zeppelin Airships (Les avions géants Zeppelin). L'Aérophile, year 26, nos. 15-16, Aug. 1-15, 1918, pp. 225-242, 33 figs. Plans and details of captured machine, 22 m. long, 41 m. wide. Also published in Aerial Age, vol. 8, no. 3, Sept. 30, 1918, pp. 122-125, 6 figs.

Materials of Construction. Tests of Materials Used in Aeroplane Construction (L'essai des matériaux servant à la construction des aéroplanes). Génie Civil, vol. 73, no. 10, Sept. 7, 1918, pp 188-191, 13 figs. Machines used for verifying equilibrium of parts; details and operation of Avery elongation and rupture-testing machine; tests made on textile fabrics.

Meteorology. Some Meteorological Conditions Which Increase the Danger of Flying, C. J. P. Cave. Aerial Age, vol. 8, no. 2, Sept. 23, 1918, p. 64, 2 figs. Rain, hail and snow; lightning; fog. (Concluded.)

Model Aeroplanes. Model Aeronautical Building as a Step to Aeronautic Engineering. Aerial Age, vol. 7, nos. 23, 24, 25, 26, Aug. 19, Aug. 26, Sept. 2, Sept. 9 1918, p. 1127, 1 fig., p. 1183, 1 fig., p. 1231, 16 figs., p. 1283, 1 fig., vol. 8, nos. 2 and 3, Sept. 23 and Sept. 30, 1918, p. 77, 3 figs., and p. 135, 10 figs. Aug. 19: Method of fastening and rigging main planes. Aug. 26: Construction of tail rudder, fin and propeller. Sept. 2: Compressed-air motor. Sept. 9: Details of motor; tank construction. Sept. 23: Steam-engine construction. Sept. 30: Gasoline-engine principle and construction.

Ornithopter. The Ornithopter, Herbert Chatley. Aviation, vol. 5, no. 4, Sept. 15, 1918, p. 237. Possibilities and requirements of the real bird machine.

Propellers. Notes on Airscrew Analysis, M. A. S. Riach, Aerial Age, vol. 7, no. 24, Aug. 26, 1918, pp. 1173-1179, 3 figs. Analysis of changes likely to be brought about by variation in one or more of the parameters involved in hypothesis upon which is based the theory of airscrew previously outlined by writer.

U. S. Aircraft Production. Aircraft Production in the United States. Flying vol. 7, no. 8, Sept. 1918, pp. 721-726, 738 and 744. Complete report of the Senate Subcommittee on Military Affairs.

AIR MACHINERY

Air Compressors. Lubrication of Air Compressors, W. H. Callan. Am. Mach., vol. 49, no. 13, Sept. 26, 1918, pp. 575-577. Shows that most oil experts figure on heat conditions which do not exist and recommend the wrong oil.

Persberg Installation of Hydraulic Air Compressors (Hydraulisk luftkompressoranlaggning vid Persberg), Gust. Anderson. Bihang till Jern-Kontorets Annaler, vol. 19, no. 7, July 15, 1918, pp. 271-296, 23 figs.

Blowers. Installation and Care of Sturtevant V D-5 Turbo-Blower, F. W. Sterling Jl. Am. Soc. Naval Engrs., vol. 30, no. 3, Aug. 1918, pp. 480-489, 5 figs. Operating rules; enumeration of parts; emergency governor mechanism; packing; bearings; lubrication.

Test of Sturtevant Forced Draft Blower, M. C. Stuart. Jl. Am. Soc. Naval Engrs., vol. 30, no. 3, Aug. 1918, pp. 453-479, 19 figs. Performance at various speeds, steam pressures and back pressures of non-condesning vertical turbine with cone-type fan mounted on shaft directly above turbine; performance of fan at various speeds and capacities; performance of combined unit.

Compressed-Air Applications. Uses of Compressed Air in the Modern Shop, P. C. Frank. Can. Machy. .vol. 20, no. 11, Sept. 12, 1918, pp. 309-313, 20 figs. Considerations on amount of clearance, cooling of air in cylinders and action of valve, in reference to efficient operation.

Flow of Air. The Flow of Air Through Small Coal and Other Broken Material: Report to the Doncaster Coal-Owners' Committee, John T. Storrow. Trans. Instn. Min. Engrs., vol. 55, part 4, Aug.-Sept. 1918, pp. 313-317, 1 fig., and (discussion) pp. 317-323. Experiments to ascertain under what conditions the rate of flow of air through a porous material varies directly as the ventilating pressure, and not with the square root of it, as in the case in ordinary pipes.

BIBLIOGRAPHY

BRIDGES

Bridge Reconstruction. Strengthening Poughkeepsie Bridge Superstructure. Ry. Age, vol. 65, no. 11, Sept. 13, 1918, pp. 473-476, 9 figs. Engineering features of efforts to increase capacity by changing from double track to single gauntlet track accommodations.

NOTE: — The abbreviations used in indexing are as follows: Academy (Acad.); And (&); American (Am.); Associated (Assoc.); Association (Assn.); Bulletin (Bul.); Bureau (Bur.); Canadian (Can.); Chemical or Chemistry (Chem.); Electrical or Electric (Elec.); Electrician (Elecn.); Engineer-s (Engr.-s); Engineering (Eng.); Gazette (Gaz.); General (Gen.); Geological (Geol.); Heating (Heat.); Industrial (Indus.); Institute (Inst.); Institution (Instn.); International (Int.); Journal (Jl.); London (Lond.); Machinery (Machy.); Machinist (Mach.); Magazine (Mag.); Marine (Mar.); Materials (Matls.); Mechanical (Mech.); Mining (Min.); Municipal (Mun.); National (Nat.); New England (N.E.); New York (N.Y.); Record (Rec.); Refrigerating or Refrigeration (Refrig.); Review (Rev.); Railway (Ry.); Scientific or Science (Sci.); Society (Soc.); United States (U.S.); Ventilating (Vent.); Western (West.); State Names (Ill., Minn., etc.); Proceedings (Proc.); Transactions (Trans.); Supplement (Supp).

Reinforced-Concrete Bridges. A New Type of Iron Concrete Arch, M. Frontard. Eng. & Cement World, vol. 13, no. 4, Aug. 15, 1918, p. 37. Structure built by bridging out with rails bent to curvature of arch and finishing with concrete. (From Annales des Ponts et Chaussées.)

The Canadian Pacific Railway's Second Track Work Between Leaside Junction and North Toronto. Can. Ry. & Marine World, no. 247, Sept. 1918 pp. 378-380, 5 figs. Features of design of 386-ft. reinforced-concrete bridge over reservoir ravine; structure supported on two abutments and five towers.

Steel Arch Bridges. The Economics of Steel Arch Bridges, Indian Eng., vol. 64, nos. 3 and 4, July 20 and 27, 1918, pp. 39-41 and 53-54. Formulae for weights of metal in arches per linear foot of span, based on designing specifications (Continuation of serial.)

BUILDING AND CONSTRUCTION

Camp Model Towns. Construction Camps Model Towns on Miami Flood Works. Eng. News-Rec., vol. 81, no. 13, Sept. 26, 1918, pp. 575-578, 8 figs. Details of plan of village and floor plans of houses; village comprises houses, schools, community halls, markets, water mains, lights and sewers.

Concrete Culverts. Standard Practice in Concrete Culvert Construction, H. Colin Campbell. Eng. & Cement World, vol. 13, no. 4, Aug. 15, 1918, pp. 19-20. Tables giving relation between area drained and area of waterway, and data on reinforced-concrete box culverts.

Foundations. Foundation Construction for New Station at Kansas City. Elec Rev., vol. 73, no. 13, Sept. 28, 1918, pp. 492-493, 7 figs. Problems encountered in the work on 150,000-kw. plant on Missouri River.

House Construction. House Construction and Design. Contract Rec., vol. 32, no. 35, Aug. 28, 1918, pp. 677-679, 7 figs. Various types and sizes of concrete houses adopted for work of reconstruction of Halifax.

Mill Buildings. Reconstruction of Consumers' Cordage Plant at Dartmouth. Contract Rec., vol. 32, no. 35, Aug. 28, 1918, pp. 687-688, 4 figs. Description of repair and reconstruction of buildings severely damaged by Halifax explosion.

Office Building. The Office Building of the Department of the Interior, Charles Butler. Architectural Rec., vol. 44, no. 3, Sept. 1918, pp. 199-123, 17 figs. Plans and elevations.

Piles. Carrying Capacity for Various Types of Piles, H. W. Young. Eng. & Cement World, vol. 13, no. 7, Oct. 1, 1918, pp. 28-29. Strengths computed by Patton's formula for a 30-ft. pile under average soil conditions.

CEMENT AND CONCRETE

By-Products. Conserving the By-Products of the Cement Mills, W. G. Clark. Eng. & Cement World, vol. 13, no. 7, Oct. 1, 1918, pp. 61-62, 1 fig. Opportunities in increasing efficiency by recovery of potash dust.

Concrete Proportioning. Methods of Proportioning Concrete Based on Recent Experimental Work, D. A. Abrams, Jl. Eng. Inst. of Can., vol. 1, no. 5, Sept. 1918, pp. 206-207. Notes based on author's work at Lewis Institute.

Concrete, Shock-Resisting. A New Shock Resisting Concrete, Can. Machy., vol. 20, no. 9, Sept. 5, 1918, pp. 297-298. Proportions of ingredients in concrete composed of portland cement with particles of moss, turf, or wood (pulverized or pulped), and metallic ores, with a binding liquid consisting of a soluble salt of alumina, lime and water.

Deterioration. Causes of the Disintegration of Concrete, A. G. Blackie. Jl. Eng. Inst. of Can., vol. 1, no. 5, Sept. 1918, pp. 200-203, Comparison of theories advanced by Montana Experimental Station, Bul. 81, Feb. 1911, and by Bureau of Standards, Tech. Paper 95, 1917, with results of work developed at Univ. of Wyoming Experimental Station, Bul. 113, Mar. 1917; account of author's tests made by determining action of various alkali solutions upon sands used locally in composition of concrete.

Chemistry of Concrete, Arch. Blackie. Can. Engr., vol. 35, no. 10, Sept. 5, 1918, pp. 231-233. Former and present theories explaining the disintegration of concrete; rules for making tile; distintegrated sewers; alkali action on sands: Winnipeg water district tests. Paper before Saskatoon Section, Eng. Inst. of Can.

Observations of Concrete Failures, H. McI. Weir. Jl. Eng. Inst. of Can., vol. 1, no. 5, Sept. 1918, pp. 203-206. Report of investigating committee appointed by Calgary Branch, particularly in relation to alkali conditions.

Reinforced Concrete v. Salt, Brine, and Sea-Water, H. J. M. Creighton. Page's Eng. Weekly, vol. 33, no. 726, Aug. 9, 1918, pp. 66-67. Corrosion of iron reinforcement due to action of brine; probable reactions which occur when metal comes in contact with a salt solution. Paper before Faraday Soc. (To be continued.) Also published in Min. Jl., vol. 122, no. 4329, Aug. 10, 1918, pp. 473-475.

The Deterioration of Concrete Due to Alkali Conditions. Contract Rec. vol. 32, no. 37, Sept. 11, 1918, pp. 743-745. Causes of distintegration; tables of analysis of samples; conclusions. Report presented by Calgary Branch Committee before Eng. Inst. óf Canada.

Oil and Concrete. Effect of Oil on Concrete, C. P. Bowie. Practical Engr., vol. 58, no. 1642, Aug. 15, 1918, pp. 79-80. Reports on experiments performed under auspices of So. Pac. RR. Abstracted from Oil Storage Tanks and Reservoirs, Bul. 155, Bureau of Mines, Washington.

Portland Cement. Government Specifications for Portland Cement. Eng. & Cement World, vol. 13, no. 7, Oct. 1, 1918, p. 17. Definition, chemical limits, specific gravity, fineness, soundness, time of setting, tensile strength, packages and marking, storage, inspection, rejection, and treatment of samples.

CHEMICAL TECHNOLOGY

Flames. Residual and Extinctive Atmospheres of Flames, T. F. Eric Rhead. Jl. Soc. Chem. Ind., vol. 37, no. 16, Aug. 31, 1918, pp. 274T-278T, 2 figs. Experimental determination of oxygen contents for flames of various gases, the inert gas employed for the extinctive atmosphere being nitrogen.

Gasoline. The Recovery of Gasoline from Natural Gas, W. P. Dykema. Petroleum, Rev., vol. 39, no. 841, pp. 138-140. Considerations to be made before designing a compression plant to treat natural gas from a given area. (To be continued)

High-Temperature Processes. High Temperature Processes and Products, Chas. R. Darling. Jl. Royal Soc. of Arts, vol. 66, no. 3432, Aug. 30, 1918, pp. 635-642, 8 figs. Thermit processes and application of thermit to welding of iron and steel; electric steel smelting; fixation of atmospheric nitrogen; formation of calcium carbide; carborundum and allied substances.

Natural Gas. The Chemical Possibilities of Natural Gas, J. B. Garner. Chem. Engr., vol. 26, no. 7, June 1918, pp. 245-254. Uses of nitrogen contained in discharge gases from gas engines in production of compounds of industrial importance. Paper before Nat. Gas. Assn. of America.

Petroleum. Studies on the Absorption of Light Oils from Gases, Harold S. Davis and Mary Davidson Davis, Jl. of Ind. & Eng. Chem., vol. 10, no. 9, Sept. 1918, pp. 718-725, 5 figs. Theory of washing process for the absorption of benzene vapor; determination of vapor pressure of benzene from its solution in high-boiling American petroleum oil; determination of average molecular weight of oil when dissolved in benzene by lowering freezing point; theory of washing processes for the absorption of light oil vapors.

Potash. The Recovery of Potash as a By-Product in the Manufacture of Portland Cement, John J. Porter. Am. Fertilizer, vol. 49, no. 5, Aug. 31, 1918, pp. 58-72. Possibilities of industry; problem of liberation; solubility of potash; electrical precipitation; estimating recovery; cost calculations.

Rubber. Comparative Methods for Determining the State of Cure of Rubber, H. P. Stevens. Jl. Soc. Chem. Ind., vol. 37, no. 16, Aug. 31, 1918, pp. 280T-284T, 5 figs. Formulation of degree of vulcanization in reference to (1) percentage of combined sulphur calculated in rubber present, (2) physical properties of vulcanizate, particularly load supported per unit cross-sectional area at a given elongation, or vice-versa.

Moisture in Raw Rubber, G. Stafford Whitby. Jl. Soc. Chem. Ind., vol. 37, no. 16, Aug. 31, 1918, pp. 278T-280T. 1 fig. Records of observations made under tropical conditions on variations of water content of raw rubber and its relation to humidity of atmosphere, form of the rubber, and pressure of serum solids.

Sulphur. Sulphur from Coal. Gas. Jl., vol. 143, no. 2880, July 23, 1918, p. 159, 1 fig. German feld process for simultaneous recovery of sulphur and ammonia by washing coal gas, with a solution of ammonium tetrathionate.

Sulphuric Acid. Some Observations on Sulphuric Acid Plants, New and Old (IV). Gas World, vol. 49, no. 1776, Aug. 3, 1918, pp. 18-19. Spent oxide as a source of sulphur; purification of coke-oven gas.

Sulphuric Acid in 1917, Philip S. Smith. Am. Fertilizer, vol. 49, no. 5, Aug. 31, 1918, pp. 78-86. Conditions of industry; uses; production; ores used in manufacture of acid.

The Thermal Properties of Sulphuric Acid and Oleum, Alfred W. Porter Trans. Faraday Soc., vol. 13, part 3, June 1918, pp. 373-399, 4 figs. and (discussion) pp. 399-400. Experimental data; formulæ and chart for determining heat of total evaporation for mixtures of sulphuric acid and water.

Water Softening. Increasing the Capacity of a Water Softener, C. R. Knowles. Ry. Maintenance Engr., vol. 14, no. 9, Sept. 1918, pp. 297-298, 4 figs. How railroad plant increased its capacity from 12,000 to 14,000 gal. per hr. by utilizing 100,000-gal. reservoir for storage of untreated water.

COAL INDUSTRY

By-Products. Liquid Fuel From Coal, W. R. Ormandy. Autocar, vol. 41, no. 1195, Sept. 14, 1918, pp. 257-258, 1 fig. The interrelation of pig iron, coke and benzol; report of Coal-Conservation Committee as affecting supply of fuel to motorists.

Coke. Pressure Regulation on By-Product Coke Ovens. Frederick H. Smoot. Gas World, vol. 49, no. 1776, Aug. 3, 1918, pp. 19-20, 2 figs. Valve arrangement and exhauster regulation. (From Iron Age, July 1, 1918.)

The Manufacture of Metallurgical Coke, With Special Reference to the Recovery of By-Products, W. A. Bone. Iron & Coal Trades Rev., vol. 97, no. 2635, Aug. 30, 1918, p. 231. Appendix to final report of Coal Conservation Committee specifying quality of coal best adapted for manufacture of metallurgical coke.

The New Coke Furnaces of the Thornaby Steel Mills, at Stockton-on-Tees, England, (Les nouveaux fours coke des aciéries de Thornaby Stockton-on-Tees) Génie Civil, vol. 72, no. 26, (whole no. 1872), June 29, 1918, pp. 469-472, 6 figs. Process for manufacturing metallurgical coke and recovering the by-products.

Distillation. Low-Temperature Distillation of Illinois and Indiana Coals, G. W. Traer. Bul. Am. Inst. Min. Engrs., no. 141, Sept. 1918, pp. 1463-1470, 1 fig. Account of practical work directed toward commercial adaptation of principle demonstrated by Parr, namely the caking bituminous coal when subjected to temperature less than 1000 deg. fahr. in a retort from which air has been excluded, will yield light tar of about 1.06 sp. gr. and high value; also, this yield with a given coal will depend upon percentage of hydro-carbons in coal, maximum temperature used, and promptness with which distillate gases are removed.

Fuel Conservation. Coal Conservation Committee's Final Report. Iron & Coal Trades Rev., vol. 97, no. 2634, Aug. 23, 1918, pp. 199-200. Report of Mining Sub-Committee on Proposed Ministry of Mines and Minerals.

Loss and Waste in Coal Production. Iron & Coal Trades Rev., vol. 97, no. 3634, Aug. 23, 1918, pp. 227-230. From final report of Coal Conservation Committee.

Statistics. Coal in 1916, C. E. Lesher. U. S. Geol. Survey, II; 35, Mineral Resources of the United States, 1916-Part II., Aug. 17, 1918, pp. 901-991. Statistics of production, distribution and consumption in United States.

CONCRETE

(See Cement and Concrete)

CONVEYING

See Hoisting and Conveying

ELECTRICAL ENGINEERING

ALTERNATORS. The Behavior of Alternators with Zero Power Factor Leading Current, E. D. Newbury. Elec. Jl., vol. 15, no. 9, Sept. 1918, pp. 363-365, 5 figs. Curves showing excitation characteristics and saturation conditions required for stable self-excitation.

CABLES. Aerial Cable Construction for Electric Power Transmission, E. B. Meyer, Elec. News, vol. 27, no. 17, Sept. 1, 1918, pp. 25-27, 4 figs. Design, construction and suspension of special cable used by company supplying light and power to 170 manufacturing plants. Paper before Am. Inst. Elec. Engrs.

CONTROL SYSTEMS. Automatically Remote Controlled Synchronous Motor-Generator Substation, William Thomas Snyder. Elec. Rev., vol. 73, no. 11, Sept. 14, 1918, pp. 407-409, 5 figs. Relative cost of automatic and manually-operated substation and costs of operating such a station of 100-kw. capacity.

Control System for Groups of Motors in a Cement Mill, William H. Easton. Rock & Cement World, vol. 13, no. 5, Sept. 1, 1918, pp. 61-62, 3 figs. Group of eleven motors — nine 150 H.P. 2200 volt, Westinghouse squirrel-cage motors driving 5½ by 22 ft. tube mills, and two 250 H.P., 2200 volt Westinghouse vertical squirrel-cage motors, cement mill type, driving Bradley grinders, controlled by system recently installed.

ELECTROMAGNETS. D. C. Lifting Magnets (Electro-aimants de levage à courant continu), J. A. Montpellier. L'industrie électrique, year 27, no. 628, Aug. 25, 1918, pp. 305-307, 3 figs. Characteristics of each one of the five types built by the Société de l'Éclairage Électrique.

EXCESSIVE VOLTAGES. Insulation and Damages from Excessive Potentials (Isolation och öfverspannings-skydd), W. Borggvist. Elektroteknik, vol. 48, no. 8, Aug. 1918, pp. 95-96, 1 fig.

The Evolution of the Problem of Excessive Voltages During the Last Years (Ofverspanningsfragans utveckling under de senaste aren), E. Alm, Elektroteknik, vol. 48, no. 8, Aug. 1918, pp. 91-95, 14 figs. (Concluded.)

The Protection of Electrical Apparatus, P. M. Lincoln. Elec. Jl., vol. 15, no. 9, Sept. 1918, pp. 346-348. Brief review of various methods by which integrity of electrical insulation may be secured and permanently assured.

HEATING OF CONDUCTORS. Investigation of Heating of Conductors, Henry C. Horstman and Victor Tousley. Elec. World, vol. 72, no. 11, Sept. 14, 1918, pp. 489-490, 2 figs. Evidence indicates that National Electric Code rating should be modified to permit use of smaller conductors where load is intermittent; data on heating produced by continuous loads.

INDUCTIVE CAPACITY. Change of Specific Inductive Capacity with Temperature and Impregnation of Paper. H. C. P. Weber and T. C. Mackay. Jl. Franklin Inst., vol. 186, no. 3, Sept. 1918, pp. 374-377, 2 figs. Curves showing results obtained for various substances alone and in conjunction with impregnated paper, at Westinghouse Elec. & Mfg. Co.'s laboratory.

LIGHTING. Electric Lighting from Three-Phase Circuits, Terrell Croft. Southern Engr., vol. 30, no. 2, Oct. 1918, pp. 44-48, 14 figs. Suggestions for laying out systems, transformers and auto-transformers; industrial applications.

MOTORS. A Large Rolling-Mill Motor. Elec. Times, vol. 54, no. 1398, Aug. 1, 1918, pp. 74-75, 3 figs. Features of electrification of Frodingham Iron and Steel Works.

Causes of Overheated Motors and Motor Noises, M. A. Saller. Southern Engr., vol. 30, no. 2, Oct. 1918, p. 49. Improperly fitted or tight bearings, defective oil rings, unequal air gap, small brushes.

High-Power Factor Induction Motors, Marius Latour. Elec. World. vol. 72, no. 11, Sept. 14, 1918, pp. 484-489. 19 figs. Summary of various arrangements for variable-speed motors of above description proposed in last 15 years. with particular reference to French developments.

How to Buy Direct-Current General-Utility Motors, A. Brunt. Am. Mach., vol. 49, no. 12, Sept. 19, 1918, pp. 532-534, 6 figs. Suggestions for Buyers.

Low Over-All Cost and Continuous Production, A. F. Lewis. Elec. World, vol. 72, no. 13, Sept. 28, 1918, pp. 592-595, 5 figs. Factors that must be considered in purchasing, installing and maintaining induction motors designed to assist in these objects.

Oerlikon Three-Phase, Low-Speed, Variable-Speed Motors with large Flywheel Effect, for Direct Coupling to Mine Ram Pumps. Elecn., vol. 81 no. 2101, Aug. 23, 1918, pp. 352-354, 7 figs. General description with diagrams and illustrations.

RECORDING INSTRUMENTS. The Use of Graphic Instruments in Improving the Operation of Electrical Apparatus and Reducing Cost of Maintenance, J. H. Overpeck. Elec. Jl., vol. 15, no. 9, Sept. 1918, pp. 354-357, 3 figs. Forms for keeping records of motor failures.

SAFETY MEASURES. Installation and Care of Large Electrical Apparatus for Steel Mills, O. Needham. Elec. Jl., vol. 15, no. 9, Sept. 1918, pp. 333-336, 2 figs. Insulation protection; handling, storing, erecting and starting; operation and care.

SUBSTATIONS. Large Underground Synchronous Substation, R. P. Hines. Coal Age, vol. 14, no. 10, Sept. 5, 1918, pp. 434-436, 4 figs. Description of substation in bituminous coal mine and its equipment.

Largest Portable Substation Yet Produced, B. H. Lytle. Elec. Ry. Jl., vol. 52, no. 11, Sept. 14, 1918, pp. 467-468, 6 figs. Long Island Railroad's portable substation used in parallel with permanent substations to help with excessive loads or as a separate substation.

TRANSFORMERS. The Essentials of Transformer Practice (XIV), E. G. Reed. Elec. Jl., vol. 15, no. 9, Sept. 1918, pp. 365-367, 3 figs. Formulæ for calculations of electrical quantities in reactors with magnetic circuit either of air or iron.

Transformer Connections, Waldo Bennett, Southern Engr., vol. 30, no. 2, Oct. 1918, pp. 52-53, 9 figs. Relations of windings in single, two and three-phase; special connections.

TRANSIENT PHENOMENA. Some Transient Phenomena in Electrical Supply Systems, E. W. Marchant. Jl. Instn. E. E., vol. 56, no. 276, July 1918, pp. 445-455, 17 figs. and (discussion), pp. 455-471, 7 figs. Records oscillograms taken on Liverpool Corporation electric supply system. Also tests of similar phenomena under laboratory conditions.

TURBO-GENERATORS. High Speed Turbo-Generators. Practical Engr., vol. 58, no. 1645, Sept. 5, 1918, pp. 114-116, 6 figs. Details of construction of rotors and stators. (Continued.)

VOLTAGE REGULATION. Improving Power Factor and Voltage Regulation, J. T. Peyton. Elec. World, vol. 72, no. 11, Sept. 14, 1918, pp 492-493, 3 figs. By using synchronous condensers, a Pennsylvania company has met increased demand without additional generating equipment and has reduced transmission losses.

ENGINEERING MATERIALS

ALUMINUM. The Alterability of Aluminum and the Properties of Its Various Alloys, Jean Escard. Sci. Am. Supp., vol. 86, no. 2225, pp. 127-128. Factors affecting alterability; properties of commercial aluminum; alteration as determined by Le Chatelier; uses and requirements; aluminum bronzes; other alloys. From Revue Scientifique.

ASPHALT. Standardization of Required Consistency for Asphalt, J. R. Draney. Good Roads, vol. 16, no. 14, Oct. 5, 1918, p. 131. Reviews present practice and suggests standardization. (Am. Soc. Mun. Improvements.)

BOILER PLATES. A Cause of Failure in Boiler Plates, Walter Rosenhain and D. Heinsen. Iron Age, vol. 102, no. 11, Sept. 12, 1918, pp. 632-636, 15 figs. Effect of grain growth; alteration of crystalline structure by mechanical deformation; some remedies. (Iron & Steel Inst., London, May 1918.)

An Unfair Advantage in Welding Boiler Plate, Howard L. Boyd. Power, vol. 48, no. 14, Oct. 1, 1918, pp. 504-506, 7 figs. Dangers of using metal for welding boiler plate which is of a chemical composition different from that of metal in plates. From California Safety News of Industrial Accident Commission of Cal.

Causes of Failure in Boiler Plates, Walter Rosenhain and D. Heinsen. Marine Eng. of Can., vol. 8, no. 9, Sept. 1918, pp. 225-228, 15 figs. Effect of grain growth; alteration of crystalline structure by mechanical deformation; suggested remedies. Iron & Steel Inst. paper.

BRONZE. The Microstructure and Value of Manganese Bronze. Shipbuilding & Shipping Rec., vol. 12, no. 10, Sept. 5, 1918, pp. 232-234, 1 fig. Values of alloy in each of two sources of introducing manganese into bronze, copper and manganese and ferromanganese.

COPPER. The Action of Reducing Gases on Hot Solid Copper, Norman B. Pilling. Jl. Franklin Inst., vol. 186, no. 3, Sept. 1918, pp. 373-374. Report of results obtained at research laboratory of Westinghouse Elec. & Mfg. Co.

HARDNESS. Hardness of Soft Iron and Copper Compared, F. C. Kelley. Gen. Meeting Am. Electrochem. Soc., Oct. 2, 1918, Advance Copy, Paper 3, pp. 45-48. Results of hardness tests applied by Brinell method on samples of American "ingot iron" and ordinary commercial cold-rolled copper after being similarly treated in an electrically heated vacuum furnace.

RUBBER. Rubber Substitutes, Andrew H. King, India's Rubber Jl., vol. 56, no. 6, Aug. 10, 1918, pp. 145-146. Factors and limitations of: asphaltic materials; coal-tar and asphalt pitches; resinous substances; glue. (Concluded from proceding issue.)

SEMI-STEEL. Tracing the Development and Use of Semi-steel. Can. Machy., vol. 20. no. 11, Sept. 12, 1918, p. 319. Uses in munition manufacture in France, and in auto and truck trade.

FACTORY MANAGEMENT

COMPENSATION. Forms for Use in Recording Compensation, Coal Age, vol. 14, no. 11, Sept. 12, 1918, pp. 506-508. How to keep records which will stimulate foremen and others and make it possible to ascertain the probable effect, in cost of self-insurance, of any change in legislation.

COST SYSTEMS. Cost System for a Medium Size Foundry, D. O. Barrett. Iron Age, vol. 102, no. 14, Oct. 3, 1918, pp. 810-813, 11 figs. Various forms which have proved their usefulness after several years' experience following a period of financial loss.

Proper Factory Cost Accounting Methods, Joseph Mack. Am. Industry, vol. 19, no. 2, Sept. 1918, pp. 17-18. How to distribute overhead expenses. Address before International Assn. of Mfg. Photo-Engravers.

DRAFTING DEPARTMENT. Drawing-Room System in the Engineering Department, G. F. Hamilton. Am. Mach., vol. 49, no. 11, Sept. 12, 1918, pp. 485-487, 10 figs. Method for recording drawings and insuring correction of copies sent into shop.

Organization and Wage Payment for the Drafting Department, J. B. Conway. Am. Mach., vol. 49, no. 13, Sept. 26, 1918, pp. 555-558, 4 figs. Description of plan in practical operation under conditions similar to those set forth in the article.

PRODUCTION. Graphic Production Control, C. E. Knoeppel. Indus. Management, vol. 56, no. 3, Sept. 1918, pp. 177-180, 2 figs. First of series. Underlying and basic principles.

Keeping Track of Production, H. A. Russell. Indus. Management, vol. 56, no. 3, Sept. 1918, pp. 231-234, 4 figs. Key to methods described is a summary card, the production-operation cost record, upon which are entered all vital facts in regard to progress of every manufacturing order, and upon which is also kept a running inventory of all parts in stock.

Production Comparisons, Walter D. Fuller. Gas Industry, vol. 18, no. 7, July, 1918, p. 241. Methods employed for determining actual and possible production.

RENTS. Overhead Rent. Gas Industry, vol. 18, no. 7, July 1918, p. 239. Plan for distributing all expenses incident to occupying buildings and grounds for manufacturing, storage and office purposes.

SALVAGE. Salvage at the Winchester Plant, Charles M. Horton. Indus. Management, vol. 56, no. 3, Sept. 1918, pp. 201-204, 8 figs. How scrap and spare material to annual value of millions of dollars is reclaimed and utilized.

SMALL JOBS. Reducing the Time Occupied in Doing the Small Job. Ry. Maintenance Engr., vol. 14, no. 9, Sept. 1918, pp. 299-302. Five discussions of work done by bridge and building departments of different railroads.

STORES. Efficiency in the Handling of Railway Supplies, Charles L. Parks. Ry. Age, vol. 65, nos. 10 and 11, Sept. 6 and Sept. 13, 1918, pp. 423-427, 3 figs., pp. 491-493. Sept. 6: Methods employed by Santa Fe in storing, handling distributing and accounting for material. Sept. 13: Line stock; ordering material; surplus and obsolete material; inventories.

Railway Stores Methods and Problems, W. H. Jarvis. Ry. Gaz., vol. 29, nos. 6 and 7, Aug. 9 and Aug. 16, 1918, pp. 155-158, and pp. 181-184. Aug. 9: Method of dealing with invoices; four-weekly balance sheets; issuing prices. Aug. 16: Stock inventories; stores sold accounts; auditing and verification of stocks.

WASTE. The Elimination of Waste. Cassier's Eng. Monthly, vol. 54, no. 3, Sept. 1918, pp. 143-149. Suggestions as to how industrial waste can be cut down and scrap material reclaimed.

FORGING

DROP FORGING. Drop Forging in Automobile and Aircraft work. Automobile Engr., vol. 8, nos. 116 and 118, July and Sept. 1918, pp. 190-192, 16 figs., pp. 261-263, 10 figs. Details of typical plant, with description of modern tools necessary for drop forging and methods.

FORGING MACHINE. Possibilities of the Forging Machine, E. R. Hagen. Am. Drop Forger, vol. 4, no. 8, Aug. 1918, pp. 301-305, 2 figs. Uses of the upsetter machine in railroad and locomotive shops.

FUEL. Fuel Analysis of a Drop Forge Plant (1), B. K. Read. Am. Drop Forger, vol. 4, no. 8, Aug. 1918, pp. 307-312, 3 figs. Charts showing daily fuel and power consumption, results of installing new heating equipment, steam consumption on hammers and cost of steam in dollars per hammer-hour. From paper before Am. Drop Forge Assn.

HAMMER FOUNDATIONS. Question of Correct Hammer Foundations, Terrell Croft. Am. Drop Forger, vol. 4, no. 8, Aug. 1918, pp. 300-304, 4 figs. Discussion of functions of hammer foundation; results of poor installation; designs and data for different types.

PISTON RODS. The Care and Maintenance of Piston Rods, G. C. Stebbins. Am. Drop Forger, vol. 4, no. 8, Aug. 1918, pp. 298-299, 1 fig. Information regarding treating of piston rods; explanation of central oiling system and its relation to maintenance of hammers. Before Am. Drop Forge Assn.

FOUNDRY

BRASS CASTINGS. How Brass Carburetors are Molded and Cast. Foundry, vol. 46, no. 10, Oct. 1918, pp. 465-469, 10 figs. Molding machines of jar-ram squeeze type extensively employed; workmen held responsible for quality of product.

CENTRIFUGAL CASTING. Casting Rings in Centrifugal Machine, E. P. Cone. Iron Age, vol. 102, no. 14, Oct. 3, 1918, pp. 801-807, 8 figs. Large quantity production by De Lavaud process; unusual properties of metal.

CORE SAND. Suggestions on Mixing Foundry Core Sand, Robert Grimshaw. Iron Age, vol. 102, no. 14, Oct. 3, 1918, pp. 807. Analysis of method for securing best porosity and strength in cores.

DIE CASTINGS. The Design of Die Castings, M. Stern. Am. Mach., vol. 49, no. 13, Sept. 26, 1918. pp. 549-551, 3 figs. Practical suggestions for designer.

FLUIDITY OF IRON. The Fluidity of Molten Cast Iron, Matthew Riddell. Foundry Trade Jl., vol. 20, no. 199, July 1918, pp. 364-366, 1 fig. Attempt to explain peculiarity of cupola observed by author, which consists in greater fluidity being obtained when the bed coke is not well lighted above the tuyeres before the blast is put on and the first iron takes long to come down. Paper before British Foundrymen's Assn.

FOREIGN METHODS. American and Foreign Steel Foundries. Iron Age, vol. 102, no. 14, Oct. 3, 1918, pp. 808-809. A British comparison of French. Belgian and American steel castings; our molding and annealing called inferior.

FOUNDRY INDUSTRY. Foundry Industry Makes Big Gain in Two Years. Foundry, vol. 46, no. 10, Oct. 1918, pp. 455-460, 7 figs. Statistics on growth of foundries.

FOUNDRY LOSSES. How the Engineer Stops Foundry Losses, Stephen B. Phelps. Indus. Management, vol. 56, no. 3, Sept. 1918, pp. 209-211, 6 figs. Defective castings, a total loss of foundry labor and supplies, can be prevented by proper design.

MAN POWER. Your Biggest Foundry Problem — Man power, H. Col Estep. Foundry, vol. 46, no. 10, Oct. 1918, pp. 443-450, 13 figs. War demands more castings with less labor; machines must do work of men.

PATTERNS. Mounting Patterns on Plates an Aid to Molding. R. R. Clarke. Foundry, vol. 46, no. 10, Oct. 1918, pp. 451-454, 3 figs. Various methods described and their advantages and disadvantages discussed from stand-point of both foundryman and patternmaker.

Taking the Pattern Shop Out of the Attic, F. L. Prentiss. Iron Age, vol. 102, no. 11, Sept. 12, 1918, pp. 640-641, 2 figs. Cleveland patternmaker believes business should be banished from dingy quarters and puts his ideas into practice.

The Making of Better Patterns, Ellsworth Shelden. Am. Mach., vol. 49, no. 14, Oct. 3, 1918, pp. 617-629, 10 figs. Requirements of a good patternmaker.

STEEL CASTINGS. Steel Castings Design and Manufacture, Foundry Trade Jl., vol. 20, no. 199, July 1918, pp. 375-378. Discussion of paper presented before British Foundrymen's Assn., published in June issue.

The Manufacture of Steel Castings, E. F. Lange. Foundry Trade Jl., vol. 20, no. 199, July 1918, pp. 372-374. Comparison of American with European standard and practice. (Sequel to Development in the Manufacture of Steel Castings, Feb. 1917.)

VENTS. Venting Moulds and Cores, S. G. Smith. Foundry Trade Jl., vol. 20, no. 199, July 1918, pp. 367-371, 18 figs. Suggestions to apprentices on proper manner of providing passages for free escape of expanded air and gases.

FUELS AND FIRING

AIR PROPORTIONS. Calculating the Excess of Air Used in Combustion, A. H[illegible]. Gas Jl., vol. 143, no. 2881, July 30, 1918, p. 206. States that when volume, G, of producer gas is burned, volume of air required is [illegible] R [illegible] G, but R [illegible], where R is volume of products of combustion, c contraction and d expansion due to combustion. (Jl. Soc. Chem. Ind.)

ALCOHOL. Alcohol as Power Fuel. Gas & Oil Power, vol. 13, no. 155, Aug. 1, 1918, pp. 159-160. Account of research in production and adaptation of alcohol for power-fuel purposes carried out in Australia by a special committee under Commonwealth Advisory Council of Science and Industry.

BITUMINOUS COAL. Burning Bituminous Coal in House-Heating Boilers, W. A. Pittsford. Heat. & Vent, Mag., vol. 15, no. 9, Sept. 1918, pp. 23-27, 15 figs. From address before Smoke Prevention Assn., Newark, Aug. 1918.

Method of Fixing Prices of Bituminous Coal Adopted by the United States Fuel Administration, C. Garnsey, R. V. Norris, and J. H. Allport. Bul. Am. Inst. Min. Engrs., no. 141, Sept. 1918, pp. 1411-1433, 6 figs. Discussion of four methods considered by Engineers Committee: namely, actual cost at colliery plus fixed sum or percentage; actual cost at colliery plus graduated profit decreasing as costs increase; prices fixed on average cost in each district all coal sold at average cost of district plus profit, and return to colliery adjusted through clearing house at price proportioned to cost of production.

CARBON DIOXIDE. Placing CO_2 on Financial Basis. Eng. & Cement World, vol. 13, no. 4, Aug. 15, 1918, pp. 62-64. Chart to estimate money lost up the stack due to low carbon dioxide, prepared for use of central-station engineers.

COAL STORAGE. Coal Storage in Large Quantities, Henry J. Edsall. Indus. Management, vol. 56, no. 3, Sept. 1918, pp. 193-200, 20 figs. Methods, equipment and typical installations, diagrams of arrangements of tracks and piles.

Handling Roundhouse Coal. Power, vol. 48, no. 11, Sept. 10, 1918, pp. 372-375, 10 figs. Describes modern coal-handling system of belt conveyors for stocking and conveying coal to bins for locomotive and boiler-room use, installed at new Croxton roundhouse of Erie R. R.; capacity, 100 tons per hr.

Physical and Chemical Changes in Stored Coal. Gas Age, vol. 42, no. 6, Sept. 16, 1918, pp. 245-247, 5 figs. Results of tests. Translated from Revue Générale de l'Electricité.

Public Utility Experience in Coal Storage. Gas Age, vol. 42, no. 5, Sept. 2, 1918, pp. 193-196, 6 figs. Reports from various companies, secured by Univ. of Ill.

Reinforced Concrete Coal Storage Plant, H. C. Campbell. Eng. & Cement World, vol. 13, no. 5, Sept. 1, 1918, pp. 13-15, 5 figs. Description of pockets or storage bins especially designed for requirements, capacity and location.

Spontaneous Combustion of Stored Coal, S. H. Katz. Gas Age, vol. 42, no. 5, Sept. 2, 1918, p. 200. Results of experiments showing importance of proportion of voids in a mass of stored coal exposed to air. From Tech. Rep. 170, U. S. Bureau of Mines.

Storage and Handling of Gas Coal, H. H. Stoek. Gas Age, vol. 42, nos. 5 and 6, Sept. 2, and Sept. 16, 1918, pp. 207-210, 9 figs., and pp. 255-258, 10 figs Review of investigations by Experiment Station of Univ. of Ill. Deals with locomotive crane storage; circular storage; steeple towers; Hunt System; bridge storage; swivel bridge; expense of storing.

The Storage of Bituminous Coal, John H. Anderson. Power, vol. 48, no. 9, Aug. 27, 1918, pp. 321-322. Suggestions based on author's examination of pifes on fire. Paper before Inst. of Marine Engrs.

COAL VALUATIONS. An Alinement Chart for the Evaluation of Coal, A. F. Blake. La. Planter & Sugar Manufacturer, vol. 61, no. 10, Sept. 7, 1918, pp. 156-157. Designed to determine relative values of different coals, given price per ton and chemical analysis, by calculating the relative costs of a million heat units in accordance with the methods established by U. S. Bureau of Mines.

COMBUSTION LOSSES. Combustion Losses and Their Minimization (III), Robert June. Brick & Clay Record, vol. 53, no. 6, Sept. 10, 1918, pp. 465-468, 2 figs. Heat losses in burning coal; in the dry chimney gases; due to incomplete combustion; in fuel through grate; due to superheating moisture in air and to moisture in fuel; due to visible smoke and to radiation.

Losses in the Boiler Room From Incomplete Combustion and High Stack Temperature, George H. Diman. Textile World Jl., vol. 54, no. 14, Oct. 5, 1918, pp. 82 and 87, 2 figs. Tables calculated from average conditions in New England textile mills.

DANISH FUELS. Concerning Our (Danish) Fuels (Om vore Brændselsstoffer), Gunnur Jergensen. Ingeniren, vol. 27, no. 66, Aug. 17, 1918, pp. 454-459.

FUEL CHANGES. Problems Involved in Fuel Changes, A. Bement. Power, vol. 48, no. 11, Sept. 10, 1918, pp. 380-382. Ash, not coal, the trouble maker; operatives do not change method of firing with coal. Some concrete instances and the remedies.

FUEL CONSERVATION. Bulletin for Firemen and Engineers. Textile World Jl., vol. 54, no. 14, Oct. 5, 1918, pp. 81-82. Bul. no. 3 of Mass. Fuel Administration prepared by a committee of operating engineers and firemen.

Coal Conservation Committee. Final Report. Colliery Guardian, vol. 116, no. 3008, Aug. 23, 1918, pp. 385-388, 1 fig. Final report of committee appointed in 1916 by Mr. Asquith issued by Ministry of Reconstruction.

Coal Saving Suggestions and a Few Don'ts. Aera, vol. 7, no. 2, Sept. 1918, pp. 179-180. 1 fig. Suggestions based on experience of Westinghouse Elec. & Mfg. Co.'s combustion engineers.

Conservation of Fuel Used by Public Utilities, L. R. Nash, E. B. Powell and H. Vittinghoff. Stone & Webster Jl., vol. 23, no. 3, Sept. 1918, pp. 163-177. Considers loading and operation improvements for reducing fuel consumption to minimum by gas, electric light and power companies and railroads.

Fuel Saving in Massachusetts. Aera, vol. 7, no. 2, Sept. 1918, pp. 107-118. Method in vogue which, it is estimated, will save 260,000 tons of coal during present year.

Practical Fuel Conservation, F. C. Wagner. Nat. Engr., vol. 22, no. 9, Sept. 1918, pp. 401-404. Stationary engineer's part in campaign to conserve coal; suggestions regarding equipment and operation. Paper before Ind. State Convention, Nat. Assn. Stationary Engrs.

Report of Coal Conservation Committee, Engineer, vol. 126, no. 3269, Aug. 23, 1918, p. 158, 2 maps.

Fuel Supplies. Is Our Fuel Supply Nearing Exhaustion? R. H. Fernald. Ry. Rev., vol. 63, no. 8, Aug. 24, 1918, pp. 271-275. Digest of fuel resources of the world and particularly of United States, giving statistical data as to rates of production, rates of depletion, and prospects of exhaustion. From Gen. Elec. Rev.

Furnaces. Combustion and Smokeless Furnaces, Joseph W. Hays. Steam, vol. 22, no. 3, Sept. 1918, pp. 65-70. Discussion based on nature and properties of heat and on Berthelot's Second Law regarding heat produced in a furnace. (To be continued.)

Gas Firing. Gas Firing for Boilers, T. M. Hunter. Elec. Times, vol. 54, no. 1398, Aug. 1, 1918, pp. 73-74. Remarks on advisability of firing boilers with gas. Paper before South Wales Inst. of Engrs.

Low Grade Fuels. Experience with the Combustion of Lignites, R. A. Ross. Jl. Eng. Inst. of Can., vol. 1, no. 5, Sept. 1918, pp. 208-210. Experiments at Saskatoon plant.

Method for the Combustion of Brown Coal. Marine Eng. of Can., vol. 8, no. 9, Sept. 1918, p. 241. Brief note on process based on applying conditions in water-gas producer to boiler furnace and using exhaust steam for gas production.

Suggestions for Efficiently Burning Lignites in a Domestic Furnace, R. G. McLaurin. Jl. Eng. Inst. of Can., vol. 1, no. 5, Sept. 1918, pp. 210-213, 1 fig. Prerequisites for efficient combustion of western coal are new furnace design, and control of combustible and air.

The Use of Lignite, Bagasse and Wood Waste for Power Generation and Other Purposes, John B. C. Kershaw. Engineer, vol. 126, no. 3268, Aug. 16, 1918, pp. 133-134. (Second article.)

Low-Rate Combustion. Getting Fuel Economy Under Difficulty. Black Diamond, vol. 61, no. 13, Sept. 28, 1918, p. 249. Suggestions to save coal while under low-rate combustion in hand-fired plants. From Tech. Paper No. 139, Low-Rate Combustion in Fuel Beds of Hand-Fired Furnaces, Bureau of Mines.

New England. The Fuel Situation in New England, Charles T. Main. Power, vol. 48, no. 14, Oct. 1, 1918, p. 508. From paper before New England Water Works Convention, Sept. 1918.

Oil Storage. Losses of Oil in Storage, C. P. Bowie. Jl. Soc. Automotive Engrs., vol. 3, no. 3, Sept. 1918, pp. 235-237. Data of losses by evaporator and from wooden and steel rod tanks; devices for lessening losses. From Oil Storage Tanks and Reservoirs, Bul. 155 (Petroleum Technology 41) of the Bureau of Mines.

Peat. Coal Conservation, Gas Producer Economics. Gas & Oil Power, vol. 13, no. 156, Sept. 5, 1918, pp. 167-168. Utilization of peat fuels in production of gas for suction engines.

The Value of Peat Fuel for the Generation of Steam. Engineer, vol. 126, nos. 3269 and 3270, Aug. 23 and Aug. 30, 1918, pp. 163-166, 6 figs., and pp. 178-180, 4 figs.

The Utilization of the Peat Resources of Canada, B. F. Haanel. Jl. Soc. Chem. Industry, vol. 37, no. 15, Aug. 15, 1918, pp. 258T-261T. Canadian peat deposits; description of peat; cost of manufacture; utilization for industrial purposes; paet as a source of oil and retort gas.

Pulverized Coal. A Diversified Application of Powdered Coal, Charles Longnecker. Iron Age, vol. 102, no. 11, Sept. 12, 1918, pp. 619-623, 8 figs. Pulverized fuel, distributed by compressed air to substations, used in open-hearth, annealing and other furnaces.

Fuels, E. R. Knowles. Steam, vol. 22, no. 3, Sept. 1918, p. 76. Four requirements in burning of pulverized coal and attainable with it. (Concluded from August issue.)

Powdered Coal Cuts Coal Consumption in Annealing Ovens Thirty Per Cent. Can. Machy., vol. 20, no. 9, Sept. 5, 1918, p. 300, 1 fig. Brief account of recent work done at malleable-iron plant of Am. Radiator Co., Buffalo.

Pulverized Coal Firing. Iron & Coal Trades Rev., vol. 97, no. 2636, Sept. 6, 1918, p. 265, 1 fig. Particulars of system developed by Fuller Engineering Co., of Pennsylvania.

The Possibilities of Powdered Coal as Shown by Its Combustion Characteristics, W. G. Wilcox. Steam, vol. 22, no. 3, Sept. 1918, pp. 70-75. Requirements necessary in perfect combustion, weaknesses of present methods; conclusions regarding powdered coal. Paper before N.Y. Section, Am. Chem. Soc.

Soft Coal. Burning Soft Coal in Heaters Designed for Hard Coal. Heat. & Vent. Mag., vol. 15, no. 9, Sept. 1918, pp. 21-23. Suggestions for selecting and using coal for house-heating equipment.

Stokers. Handling Jones Under-Feed Stokers, "Receiver." Power Plant Eng., vol. 22, no. 18, Sept. 15, 1918, pp. 743-744, 4 figs. Building and banking fires; precaution to observe in handling fires.

Smokeless Combustion with Chain-Grate Stokers, Thomas A. Marsh. Elec. Rev., vol. 73, no. 12, Sept. 21, 1918, pp. 448-449, 2 figs. Discussion of furnace chambers, boiler settings and baffling as affecting efficiency and smokeless combustion of high-volatile coals. Paper before Annual Smoke Prevention Convention, Newark, N.J.

The Stoker of the Future, Joseph Harrington. Elec. Rev., vol. 73, no. 12, Sept. 21, 1918, pp. 442-443. Analysis of mechanical-stoker evolution as influenced by coal characteristics, clinker, efficiency and rate of combustion.

Wood. Wood Fuel, A. Barbey. Domestic Eng., no. 277, Sept. 1918, pp. 1-3. Present situation in Switzerland. Paper before Vaudoise Soc. of Nat. Sci. From Bulletin Technique.

FURNACES

Electric Brass Furnace. A Rocking Electric Brass Furnace, H. W. Gillett and A. E. Rhoads. Brass World, vol. 14, no. 9, Sept. 1918, pp. 264-268. Description of furnace at plant of Michigan Smelting & Refining Co., with results of tests and bibliography of electric-furnace literature.

Gas Heat-Treating Furnace. Automatic Shell Heat Treating Furnaces, W. J. Harris, Jr., Iron Age, vol. 102, no. 10, Sept. 5, 1918, pp. 565-568, 8 figs. Human element superseded by mechanical devices in a new gas-fired installation at Pawtucket.

Induction Furnaces. Production of High Temperature and Its Measurement, E. F. Northrup. Trans. Faraday Soc., vol. 13, part 3, June 1918, pp. 212-221, 6 figs. Principle of operation and details of a 20-kw. electric induction simple crucible furnace.

Nitrogen-Fixation Furnaces. Nitrogen-Fixation Furnaces, E. Kilburn Scott. Gen. Meeting Am. Electrochem. Soc., Oct. 2, 1918, Advanced Copy, Paper 8, pp. 103-134, 17 figs. Review and comparison of various types of electrical furnaces; description of author's three-phase furnace and discussion of its details in comparison with other types.

Resistance Furnaces. Test on a Resistance Electric Furnace for High Temperatures (Försök med en elektrisk motstandsugn för höga temperaturer), Jakob Forssell. Tecknisk Tidskrift, vol. 48, no. 66, July 24, 1918, pp. 93-98, 4 figs.

HEATING AND VENTILATING

Electric Heating Units. Electricity as a Substitute for Gas, Frank Thornton Am. Drop Forger, vol. 4, no. 8, Aug. 1918, pp. 324-325. Comparison of electricity as heating unit with natural gas and coal; conditions which have developed electrical heating. From paper before Engrs.' Soc. of Western Pa. (To be Continued.)

Equipment. Care of Heating and Ventilating Equipment, Harold L. Alt. Power, vol. 48, no. 11, Sept. 10, 1918, pp. 383-384. First of series on economical operation.

Factories. Difficult Problems of Paper Manufacturers Solved by the Sturtevant Absorption System. Paper Mill, vol. 41, no. 40, Oct. . 5, 1918, pp. 16 and 44-46, 3 figs. Heating and ventilating ystem of large mill.

Factory Heating, Chas. L. Hubbard. Steam, vol. 22, no. 3, Sept. 1918, pp. 63-65. Methods of computing available exhaust-and-live-steam requirements. (To be continued.)

Heating and Ventilating Are Very Important (II), M. H. Potter. Can. Machy., vol. 20, no. 8, Aug. 22, 1918, pp. 225-227, 6 figs. Systems of heating buildings; machine-shop arrangements; suitable temperatures; artificial lighting.

Heating Systems. Fuel Saving Heating Systems, Alfred G. King. Domestic Eng., vol. 84, no. 8, pp. 272-274, 5 figs. How the vapor-vacuum system is installed; how it operates and how fuel is conserved.

Heating and Piping Systems. Contract Rec., vol. 32, no. 37, Sept. 11, 1918, p. 740. Points to be considered in design of a heating system.

Pressure Regulation. Pressure Regulating Devices, Chas. L. Hubbard. Domestic Eng., vol. 84, no. 9, Aug. 31, 1918, pp. 312-314, 7 figs. Notes on construction and operation of pressure-reducing valves for modern heating systems. (To be continued.)

School Buildings. School Building Heating and Ventilation, Samuel R. Lewis, Heat. & Vent. Mag., vol. 15, no. 9, Sept. 1918, pp. 33-43, 14 figs. Second article.

Turbo-Generator Ventilation. The Ventilation of Turbo-Generators, J. Humphrey. Iron & Coal Trades Rev., vol. 97, no. 2636, Sept. 6, 1918, pp. 260-261, 1 fig. Deal chiefly with question of dust removal from air.

HOISTING AND CONVEYING

Chains. Safe Chain Loads, A. Black. Machy., vol. 25, no. 1, Sept. 1918, pp. 37-39 Factors that determine safe loads and effects obtained by annealing chains.

The Manufacture and Testing of Cast Steel Chain Cables. Page's Eng. Weekly, vol. 33, no. 728, 1918, pp. 88-90. Memorandum issued by Lloyd's register of shipping.

Coal Handling. A New Design for Large Coaling Facilities. Ry. Age, vol. 65, no. 14, Oct. 4, 1918, pp. 615-616, 2 figs. Economics effected in track capacity and car supply on the Erie R. R.

Coal and Shipping. Transport from Collieries to Ports, F. J. Warden-Stevens. Colliery Guardian, vol. 116, no. 3009, Aug. 30, 1918, pp. 439-440. Description of means and equipment for shipping coal from mines to ports in the United Kingdom.

Concrete Coal Bins Prove Profitable, C. W. Hull. Eng. & Cement World, vol. 13, no. 7, Oct. 1, 1918, pp. 23-24, 2 figs. Record of successful operation and methods of unloading from cars and loading trucks.

Coal Tipples. Simpson Creek Coal Company's Tipples, R. G. Read. Coal Age, vol. 14, no. 11, Sept. 5, 1918, pp. 430-433, 5 figs. Features of design described and illustrated.

Conveyors. Conveyor at the Wellpark Brewery, Glasgow. G. F. Zimmer. Engineering, vol. 106, no. 2746, Aug. 16, 1918, pp. 165-168, 15 figs. Illustrated description of a combination push-bar or drag-link conveyor and the roller runway.

Conveyors for Chemical Works, William H. Atherton. Conveying (Supp. to Cassier's Eng. Monthly), vol. 1, no. 4, Sept. 1918, pp. xxix-xxiv, 9 figs. General arrangement of plant for handling granulated niter cake. (Continuation of serial.)

Conveyors, Robert S. Lewis. Min. & Sci. Press, vol. 117, no. 11, Sept. 14, 1918, pp. 349-355, 8 figs. Data for designing and calculating belt-conveyor systems.

Portable Automatic [illegible] Conveyor, Geo. [illegible] Zimmer. [illegible] Supp. to [illegible] Monthly, vol. 1, no. 1, Sept. 1918, pp. [illegible]. Device to handle [illegible] [illegible] steamers.

Cranes. Industrial Controllers (XXI), H. D. James. Elec. Jl., vol. 15, no. 9, Sept. 1918, pp. [illegible], 12 figs. [illegible] of cranes [illegible] of [illegible].

Elevators. Development of [illegible] Elevator, Charles [illegible]. Nat. [illegible], vol. 22, no. 9, Sept. 1918, pp. [illegible]. History of experiments, discussion of various makes of [illegible] of operating costs and details. Abstract of paper before convention of Elevator Mfrs. Assn.

Mine Locomotives. A New Type of Mine Locomotive Controller, [illegible] W. Webb. Gen. Elec. Rev., vol. 21, no. 9, Sept. 1918, pp. [illegible]-622, 8 figs. Pneumatic hand-operated control for electric power equipments.

Ore Cars. Ore Car Designed for Hecla Mine, C. T. Rice. Eng. & Min. Jl., vol. 106, no. 12, Sept. 21, 1918, pp. [illegible], 4 figs. Detailed description of a car having a capacity of [illegible] cu. ft., to be let down a shaft [illegible] ft. and pass around a 28-ft. curve on a [illegible] track.

Safety Appliances. Safety in Winding Operations (II), J. A. Vaughan. South African Jl. & Eng. Rec., vol. 27, nos. 1400 and 1401, July 27, and Aug. 3, 1918, p. 318 and pp. 296-297. July 27: Discussion of several faults or omissions of winding engine drivers, suggestions to prevent them. Aug. 3: Consideration of prevention of [illegible] and automatic application of brakes. Before S. A. A. A. S. (Continued [illegible].)

Winding Mechanism. Automatic Cable Winding Mechanism, Donald A. Baker. Machy., vol. 25, no. 1, Sept. 1918, pp. 44-45, 3 figs. Arrangement for winding cable used for making lead balls for shrapnel shells.

Wire Ropes. The Factor of Safety of Wire Ropes (II). South African Mining Jl., vol. 27, part 2, no. 1394, June 15, 1918, pp. 171-172. Author's reply to criticisms of his previous discussion, offered by other members of the Inst. Paper before S. A. I. of E.

HYDRAULICS

Dams. Calaveras Dam Slide — Report on Failure of Hydraulic Fill Dam During Construction, D. C. Henny and C. H. Swigart. Reclamation Rec., vol. 9, no. 9, Sept. 1918, pp. 433-435, 2 figs. Report of investigation ordered by chief of construction, U. S. Reclamation Service, giving original construction, tests of materials and subsequent design amendments.

Method of Keying Sections of Concrete Dam, Frank P. Fifer. Can. Engr., vol. 35, no. 9, Aug. 29, 1918, p. 210, 1 fig. Method employed in construction of lock and dam on Hudson River at Troy, N.Y.

Sixty-One-Foot Hydraulic-Fill Dam Rests on Earth Foundation, William G. Fargo. Eng. News-Rec., vol. 81, no. 11, Sept. 12, 1918, pp. 491-495, 9 figs. Junction hydro-electric development in southern Michigan notable for winter placing of earth fill and for extreme height of concrete retaining walls, which hold 90 ft. of fill.

Weighing Materials Saved Cement on Three Big Dams, H. H. Hunt. Contract Record, vol. 32, no. 37, Sept. 11, 1918, pp. 738-740. How concrete proportioned by weighing the cement, sand and gravel reduced the volume of cement used on three hydro-electric developments completed recently in Michigan and Minnesota.

Hydro-electric Plants. New Hydro-electric Plant of Montana Power Company, W. A. Scott. Eng. & Cement World, vol. 13, no. 7, Oct. 1, 1918, pp. 18-22, 2 figs. Details of hydraulic equipment of project adding 48,000 kva. tp.system.

Mysore Irrigation Project. A Great Mysore Irrigation Project. The Waste Weir of the Krishnarajasagara, B. Bubba Rao. Indian & Eastern Engr., vol. 42, no. 5, May 1918, pp. 157-158, 2 figs. Program for completing war work; protection works; calculations for stability of waste weir section. Paper before Mysore Engrs.' Assn. (Continued from preceding issue).

Tasmania Hydro-electric Development. The Great Lake Hydro-Electric Development of Tasmania, Ludwig W. Schmidt. Power, vol. 48, no. 10, Sept. 3, 1918, pp. 328-330, 7 figs. Description of some features of a 100,000-hp. hydro-electric development undertaken by private enterprise and completed with financial aid of government of Tasmania.

Water Power. Water Power Development to Conserve Coal. Ry. Rev., vol 63, no. 8, Aug. 24, 1918, pp. 268-270. Outline of legislation proposed by administration to conserve country's fuel supply and man power through resort to hydro-electric development on an extensive scale for railway purposes.

Water Power in Industry: Its Place and Value, A. Newlands. Ry. News, vol. 110, no. 2854, Sept. 14, 1918, pp. 195-196. Estimated extent to which water power has been utilized the world over. (British Science Guild.)

Water Works. War Burdens of Water-Works in the United States, Am. City, vol. 19, no. 3, Sept. 1918, pp. 1913-194. Summary of findings and conclusions of Executive Committee of Am. Water Works Assn.

Water Works Operation. Mun. Jl., vol. 45, no. 9, Aug. 31, 1918, pp. 170-171, 1 fig. Selection of service pipe — galvanized lead, lead-lined and cement-lined.

INDUSTRIAL ORGANIZATION

Depreciation. Depreciation and Rate Making, L. R. Nash. Elec. Ry. Jl., vol. 52, no. 12, Sept. 21, 1918, pp. 511-513. States that use of an undepreciated value with sinking-fund accruals for depreciation is not only justified by precedent and correct accounting principles but is desirable on ground of public policy.

Industrial Census. What an Industrial Census Can Do, Dale Wolf. Indus. Management, vol. 56, no. 3, Sept. 1918, pp. 213-216. Results of an experiment of Miller Lock Co.

Industrial Organization. New Developments in Industrial Organization, W. G. Cass. Cassier's Eng. Monthly, vol. 54, no. 3, Sept. 1918, pp. 131-142. Methods followed at Port Sunlight Works. (To be continued.)

INTERNAL-COMBUSTION ENGINEERING

Alcohol Engines. Power-Alcohol and Alcohol Engines. Automobile Engr., vol. 8, no. 116, July 1918, pp. 188-189. Notes on report of Committee of Advisory Council of Science and Industry of Australia.

Diesel Engines. Coal Tar Oil for Diesel Engines, A. W. H. [illegible]. Gas Eng., vol 20, no. 10, Oct. 1918, pp. 465-473, 11 figs. Physical and chemical characteristics of suitable coal-tar oils.

Conserving Our Natural Resources by the More Extended Use of the Diesel Engine, P. L. Scott. Sibley Jl. of Eng., vol. 32, no. 12, Sept. 1918, pp. 178-180. Shows position author believes Diesel and surface-ignition engines will occupy in conservation of present source and in use of fuels not yet widely recognized. From The Pacific Marine Review. (First of a series of six articles.)

Gas Turbines. The Gas Turbine, Georges Funck. Automobile Engr., vol. 8, no. 118, Sept. 1918, pp. 249-254, 20 figs. Two possible methods of operation of a steam turbine; illustrations of two proposed methods for gas turbine: combustion of mixture at constant pressure, and at constant volume. Efficiency obtainable in gas turbine. Paper before Graduates' Section, Instn. Automobile Engrs.

High-Speed Enginess. High-Speed Internal Combustion Engines, H. R. Ricardo. Mech. World, vol. 64, no. 1648, Aug. 2, 1918, p. 57. Range of mixture strength available with petrol; volumetric efficiency. Paper before Northeast Coast Instn. of Engrs. & Shipbuilders. (Continuation of serial. Also published in Automobile Engr., vol 8, 116, July 1918, pp. 184-188, 18 figs.

Low-Compression Oil Engines. Some Features of Low-Compression Oil Engines, L. H. Morrison. Power, vol. 48, no. 13, Sept. 24, 1918, pp. 455-458, 8 figs. Several forms of fuel injection pumps and nozzles described and information given concerning their care and repair. (Fifth article.)

Offset Cylinders. Offset Cylinders, A. Johnson, Automobile Engr., vol. 8, no. 118, Sept. 1918, pp. 244-245, 3 figs. Mathematical investigation of désaxé setting.

Rotary Engines. Augustine Rotary Two-Cycle Super-Induction Gas Engine. Gas Eng., vol. 20, no. 10, Oct. 1918, pp. 481-487, 14 figs. Description with drawings of new design of rotary air-cooled engine developed by Augustine Automatic Rotary Engine Co., Buffalo, N.Y.

Thermodynamic Cycles. Thermodynamic Cycles in Internal Combustion Engines, Wm. J. Walker. Aerial Age, vol. 8, no. 3, Sept. 30, 1918, pp. 126-127, 12 figs. Discussion of increasing power of engine by increasing mean effective pressure of cycle.

Tractor Engines. Oil Burning Tractor Engines, H. H. Sward. Jl. Soc. Automotive Engrs., vol. 3, no. 3, Sept. 1918, pp. 209-210, and discussion 210-211. Considerations regarding fuel selection.

LABOR

Contract System. Labor Shortage Made Good by Station Contract System, F. P. Kemon. Eng. News-Rec., vol. 81, no. 12, Sept. 19, 1918, pp. 542-544, 4 figs. How Winnipeg aqueduct workers speeded completion of work at contract prices which netted 30 to 40 per cent increase in wages.

Co-operative Plants. Philadelphia Co-operative Plant Extended. Elec. Ry. Jl., vol. 52, no. 11, Sept. 14, 1918, pp. 459-462. Success of the plan for producing cordial relations between labor and capital demonstrated by eight years of experience; wages now raised to equal of the highest established by War Labor Board; several changes in original plan.

Solving Labor Relationship Problems. Am. Drop Forger, vol. 4, no. 8, Aug. 1918, pp. 320-322. Account of work done by directors of a company who have asked their employees to co-operate with them and to help decide what their mutual relation should be. (To be continued.)

Cost of Living. How to Determine Cost of Living in an Industrial Community, Ray M. Hudson. Indus. Management, vol. 56, no. 3, Sept. 1918, pp. 185-192. Gives in complete detail results and basis of a cost study made for the H. H. Franklin Mfg. Co.

Cripples. Rehabilitating Cripples at Ford Plant, J. E. Mead. Iron Age, vol. 102, no. 13, Sept. 26, 1918, pp. 739-742, 8 figs. Full efficiency obtained by 85 per cent; light handwork in hospital speeds recovery.

Employee Representation. Midvale Plan of Employee Representation. Iron Age, vol. 102, no. 14, Oct. 3, 1918, pp. 834-835. Delegate for each 300; about one-tenth of these form plant committee; general committee for all plants; arbitration provided for if necessary.

Housing. Engineering Possibilities of Circular Housing Plan, G. J. Lamb. Can. Engr., vol. 35, no. 9, Aug. 29, 1918, pp. 193-196, 3 figs. Layout of block of 21 houses; particulars of water mains, sewers and maintenance.

Labor Plans. Beginnings of Labor Maintenance Service in a Small Plant, Mary L. Morris. Indus. Management, vol. 56, no. 3, Sept. 1918, pp. 205-208, 3 figs. How this work was started in a textile mill employing 500 workers; work divided into medical, employment and social divisions.

Conservation of Our Human Equipment, Earl B. Morgan. Am. Drop Forger, vol. 4, no. 8, Aug. 1918, pp. 316-318. Methods of selecting men for job; organizing methods for taking care of workmen; how to conduct investigations; centralizing control of shop activities. (Concluded from June issue.)

How a Medium-Sized Plant Solves Its Labor Problems, H. E. Sloan. Machy., vol. 25, no. 1, Sept. 1918, pp. 11. Proper-working conditions; hourly wages and bonus payments; American citizenship desirable.

Mine Labor. The Coal Shortage, F. W. Gray. Can. Min. Jl., vol. 39, no. 17, Sept. 1, 1918, pp. 291-293. True aspects of situation as seen by writer who suggests return of enlisted miners.

Training. Experience in Training Mechanical Operators. Iron Age, vól. 102, no. 10, Sept. 5, 1918, pp. 551-553, 8 figs. Machine-tool plant of medium size succeeds in effort to develop efficient workers from unskilled men and women.

How to Start Training in a Factory, Frank L. Glynn. Am. Industry, vol. 19, no. 2, Sept. 1918, pp. 22-25, 4 figs. Plan developed in Curtiss Aeroplane Co., Buffalo, and advice to manufacturers.

Industrial Training—A War Measure, C. S. Coler. Elec. Jl., vol. 15, no. 9, Sept. 1918, pp. 352-355, 4 figs. Vestibule school of Westinghouse Elec. and Mfg. Co.

Training Men and Boys in a Shop School, A. N. Hook. Am. Mach., vol. 49, no. 13, Sept. 26, 1918, pp. 567-569. Successful methods of graduating a large number of workmen and at the same time lessening the financial burden of the [illegible].

Training School at Hog Island, W. H. Blood. Stone & Webster Jl., vol. 23, no. 3, Sept. 1918, pp. 178-181, 9 figs. System followed and results being obtained.

TURNOVER. Computing Labor Turnover. Indus. Management, vol. 56, no. 3, Sept. 1918, pp. 239-240. Result of a questionnaire to determine definition of labor turnover and how it is computed in various plants.

WAGES. Living Costs and Wage Standardization, W. B. Wilson. Aera, vol. 7, no. 2, Sept. 1918, pp. 145-146. Secretary of Labor in New York address says differences as between communities may have to be disregarded and uniform rates provided for entire country.

New Wage Increase. Ry. Rev., vol. 63, no. 10, Sept. 7, 1918, pp. 335-339. Text of two supplements stabilizing wages and removing inequalities occurring in general order No. 27, United States Railroad Administration.

WOMEN WORKERS. The Employment of Women in Munition Factories, O. E. Monkhouse. Jl. Instn. Mech. Engrs., no. 4, April 1918, pp. 213-221. Unskilled types of women educated, domestic, ordinary: training of women; how they have reached their present skill; hours of work.

Training the Woman War Worker, Edward K. Hammond. Machy., vol. 25, no. 1, Sept. 1918, pp. 15-17, 3 figs. Methods used in the plant of Taft-Pierce Company, Woonsocket, R. I., in training of women machine operators by means of a "vestibule" school.

Women on Kansas City Railways, J. E. Gibson. Aera, vol. 7, no. 2, Sept. 1918, pp. 93-102, 6 figs. What has been done to make their employment attractive and to secure the best class.

Women Substation Operators a Notable Success. Elec. World, vol. 72, no. 12, Sept. 21, 1918, pp. 545-548, 6 figs. Pioneer work of Boston Edison Co. in training women for electrical service; synopsis of course of instruction.

LIGHTING

DAYLIGHT, ARTIFICIAL. Artificial Daylight in the Industries, M. Luckiesh. Elec. World, vol. 72, no. 13, Sept. 28, 1918, pp. 596-598. Qualifications of light required for color discrimination, with examples of industrial use of daylight lamps installed in many establishments varying in kind.

FACTORY LIGHTING. Laws Relating to Factory Lighting, W. T. Blackwell. Am. Drop Forger, vol. 4, no. 8, Aug. 1918, pp. 312-313. Discussion on proper application of light in shops.

Some Important Phases of Industrial Lighting, W. T. Blackwell. Elec. Rev., vol. 73, no. 10, Sept. 7, 1918, pp. 360-362, 3 figs. Conservation of labor through improved lighting; proper lighting layout a simple problem; typical example; commonly neglected features of factory lighting.

LIGHTING METHODS. The Lighting Art; Its Practice and Possibilities in Interiors. M. Luckiesh. Trans. Illuminating Eng. Soc., vol. 13, no. 6, Aug. 30, 1918, p. 354. Abstract of paper before Chicago Section of society.

Selection of Lighting Units, Davis H. Tuck. Elec. World, vol. 72, no. 12, Sept. 21, 1918, pp. 552-554, 5 figs. Simple method of analyzing distribution curves explained; efficiency of reflectors.

PAINT WORKS. Improvement of Lighting of Paint and Varnish Works, F. H. Bernhard. Elec. Rev., vol. 73, no. 13, Sept. 28, 1918, pp. 481-486, 6 figs. Seventh article on improvement of lighting in the industries.

WOODWORKING PLANTS. Need of Improved Lighting of Woodworking Plants, F. H. Bernhard. Elec. Rev., vol. 73, no. 11, Sept. 14, 1918, pp. 401-408, 8 figs. Sixth of series of articles on lighting in the industries. Present article shows how better lighting speeds up production, improves quality and reduces accidents; low cost; common faults; some suggestions for betterment.

LUBRICATION

DREDGES AND SHOVELS. Lubrication of Steam Shovels and Dredges. Eng. & Cement World, vol. 13, no. 5, Sept. 1, 1918, p. 74. Recommendation made by the Texas Co.

LUBRICATING OILS. Lubrication and Lubricating Oils, N. C. Brunn. Ry. Gaz., vol. 29, no. 8, Aug. 23, 1918, pp. 205-206. Abstract of results obtained on neutral, animal and vegetable oils. From paper before Soc. of Engrs., Tokio.

VISCOSITY. Relation Between Viscosity and the Chemical Constitution of Lubricating Oils, A. E. Dunstan and F. B. Thole. Jl. Instn. Petroleum Technologists, vol. 4, no. 16, June, 1918, pp. 191-216, 5 figs., and (discussion) pp. 216-229. Theoretical discussion on measurement of absolute viscosity; review of experimental data on American, Russian and Scotch oils, obtained by various authors; condensed bibliography.

MACHINE DESIGN

NOMOGRAPHY. Nomography in Engine Design, F. Leigh Martineau. Jl. Soc. Automotive Engrs., vol. 3, no. 3, Sept. 1918, pp. 224-243, 23 figs. Practical study of graphic representation of formulæ and construction of various diagrams. Paper before Instn. Automotive Engrs., London.

MACHINE PARTS

BEARINGS. Ball Bearings for Machine Shop Equipment, Edward K. Hammond. Machy., vol. 25, no. 1, Sept. 1918, pp. 50-58, 22 figs. Second of a series.

Refitting Engine Bearings, C. H. Willey. Mech. World, vol. 64, no. 1648, Aug. 2, 1918, pp. 56-57, 6 figs. Oil-flood method to locate knocks that develop during a run on a peak load; rebabbitting bearings. From National Engineer. (To be continued.)

Using Ball Bearings in Marine Machinery. Can. Machy., vol. 20, no. 11, Sept. 12, 1918, pp. 322-323, 6 figs. Work done in Sweden; progress made in Canada.

BELTS. Belting Problems Discussed at Chicago Meeting. Eng. & Cement World, vol. 13, no. 4, Aug. 15, 1918, pp. 56-60. Account of meeting of belt manufacturers, sales representatives and engineers at which data concerning belt performance in varied industrial plants were presented.

BOLTS. Big End Bolts. Gas & Oil Power, vol. 13, no. 156, Sept. 5, 1918, pp. 173-174, 1 fig. Discussion of their fracture and failure.

COOLERS. Saving Coal by Efficient Pulleys, Charles H. Machen. Am. Mach., vol. 49, no. 12, Sept. 19, 1918, pp. 536-538, 4 figs.

SPRINGS. Helical Springs, M. H. Sabine, Mech. World, vol. 64, no. 1648, Aug. 2, 1918, p. 55, 6 figs. Layout and formulæ to determine number of coils and free length.

MACHINE SHOP

BALANCING. Methods of Balancing Rotors, C. C. Brinton. Elec. Jl., vol. 15, no. 9, Sept. 1918, pp. 349-352, 9 figs. Static and dynamic balancing systems and machines.

BULLDOZER OPERATIONS. Bulldozer Operations with One and Two-Motion Dies, J. V. Hunter. Am. Mach., vol. 49, no. 11, Sept. 12, 1918, pp. 465-470, 20 figs. A variety of work that can be done in a bulldozer with properly designed dies.

CASE-HARDENING MATERIALS. Case Hardening, S. S. Amdursky. Gas Industry, vol. 18, no. 8, Aug. 1918, pp. 259-261, 3 figs. Result of investigations by a gas and electric company into possibilities of converting both coal and oil-fired case-hardening furnaces to use gas.

Testing the Relative Merits of Case-Hardening Materials, Clarence N. Underwood. Am. Mach., vol. 49, no 13, Sept. 26, 1918, pp. 569-571, 3 figs. Method consist in case. hardening test pieces with various materials to be tested and in measuring the results.

CUTTING METALS. The Cutting of Iron and Steel by Oxgen (XVIII), M. R. Amadeo (Translated from original French by D. Richardson). Acetylene & Welding Jl., vol. 15, no. 179, Aug. 1918, pp. 140-141, 1 fig. Peculiarities of carburized metal found in cuts made with central-jet blowpipes; formation of heating flame.

GAGE MAKING. Elements of Gage Making, C. A. Macready. Am. Mach., vol. 49, no. 12, Sept. 19, 1918, pp. 511-519, 21 figs. Amount and trend of distortion due to heating by grinding wheels. Fourth of series.

HEAT TREATMENT. Correct Heat Treatment of Die Blocks, G. Peterson. Am-Drop Forger, vol. 4, no. 8, Aug. 1918, pp. 295-297, 1 fig. Theory of crystalliza. tion and influence of mass in relation to temperature; bearing of these theories on subject.

Heat-Treating Gears for Army Trucks in the Electric Furnace, Dwight D. Miller. Am. Mach., vol. 49, no. 11, Sept. 12, 1918, p. 461, 1 fig. Benefits derived from proper heat treatment of gears; use of electric furnace for heat treatment of gears; use of electric furnace for heat treatment.

Using Electrical Furnaces for Annealing, Wirt S. Scott. Am. Drop Forger, vol. 4, no. 8, Aug. 1918, p. 323. Control equipment used; conditions for which furnace is adapted. (Concluded from June issue.)

MILLING. Milling Practice in Railway Shops, Frank A. Stanley. Ry. Mech. Eng., vol. 92, no. 9, Sept. 1918, pp. 521-524, 9 figs. Examples of cutters used with success in Southern Pacific Shops in Sacramento, Cal.

NAVY REPAIRS. War-Time Repairs in the Navy, Frank A. Stanley. Am. Mach., vol. 49, no. 14, Oct. 3, 1918, pp. 621-624, 12 figs. Describes a miscellaneous line of work and special cutters, hobs and other tools. Fourth article.

OIL RECLAMATION. Reclaiming Oil from Metal Turnings, C. L. Smith. Iron Age vol. 102, no. 10, Sept. 5, 1918, pp. 558-559, 3 figs. Scheme employed by Cincinnati Milling Machine Co., makes use of a special collecting truck and a separator set flush with floor.

PLATING. Effecting War Economics in the Plating Room. E. P. Later. Foundry, vol. 46, no. 10, Oct. 1918, pp. 461-463. How waste may be eliminated and metals, acids and other materials conserved by exercising greater care in operation.

RADIATOR MANUFACTURE. The Manufacture of the Sperry-Type Automobile Radiator. Am. Mach., vol. 49, no. 12, Sept. 19, 1918, pp. 522-524, 8 figs. Description of the sheet-metal work in making this type of radiator.

WELDING. The Autogenous Welding of Lead (III), P. Rosenberg, Acetylene & Welding Jl., vol. 15, no. 179, Aug. 1918, pp. 134-135, 8 figs. Description of hydrogen and oxy-acetylene installations.

Electric Arc Welding. Domestic Eng., no. 277, Sept. 1918, p. 5. Formula to calculate approximate heat quantities involved in welding. Paper before Cleveland Eng. Soc.

Fusion Welding Fallacies, S. W. Miller. Machy., vol. 25, no. 1, Sept. 1918, pp. 12-13, 5 figs. Third of a series.

Selection and Application of Electric Arc Welding Apparatus, A. M. Candy. Elec. Jl., vol. 15, no. 9, Sept. 1918, pp. 337-346, 25 figs. Chief requisites for electric arc welding both with alternating and direct current; constant-current vs. constant-potential generators; protective equipment and accessories; selection of electrodes; gas vs. electric arc.

WHEEL HUBS. Machining Front Wheel Hubs, A. Thomas. Automobile Engr., vol. 8, no. 118, Sept. 1918, pp. 264-266, 12 figs. Operations in manufacturing front-wheel hub from drop forging of 3 per cent nickel steel.

MACHINE TOOLS

DIES. Construction and Operation of Temporary Dies, Hugo F. Pusep. Am. Machy., vol. 49, no. 11, Sept. 12, 1918, pp. 488-489, figs. Method outlined shows how dies can be built for small output at little expense.

Double-Movement Dies for Bulldozer Work, J. V. Hunter, Am. Mach., vol. 49, no. 12, Sept. 19, 1918, pp. 508-510, 9 figs. Illustrations of cheaply made double-movement dies for use in a bulldozer.

Presses. [illegible] 1918, pp. [illegible] Set of dies for performing [illegible] operations [illegible] power press.

[illegible] July 1918, pp. [illegible] [illegible] from May [illegible]

[illegible] Machy., vol. 25, no. 1, Sept. 1918, pp. [illegible] [illegible] operations [illegible] handled [illegible] operated by power press.

MACHINERY, SPECIAL

Hosiery Machinery. [illegible] Manufacture of Hosiery Machines, Robert Mawson. Am. Mach., vol. 49, no. 13, Sept. 26, 1918, pp. [illegible], 10 figs. [illegible] but produce as equally accurate results as more complicated tools.

Sand Blast Machinery. Automatic Positive Pressure Sand Blast Apparatus. Compressed Air Mag., vol. 23, no. 9, Sept. 1918, pp. 8884-8886, 1 fig. Machine controlled by specially designed manifold valve.

MARINE ENGINEERING

Barges. Upper Mississippi River Barge Fleet, B. I. Brown. Jl. Engrs. Club of St. Louis, vol. 3, no. 4, July-Aug. 1918, pp. [illegible]-202. Data on construction and equipment of 19 steel barges, with double bottom, and four towing steamers, designed to handle up-stream tonnage against rapid currents.

Cargo Steamers. The Most Suitable Sizes and Speeds for General Cargo Steamers John Anderson. Int. Mar. Eng., vol. 23, no. 9, Sept. 1918, pp. 505-511, 13 figs. Method of determining most economical dimensions of cargo vessels for any length of voyage, condition to loading and [illegible]. Paper before Instn. of Naval Architects, London, March 1918.

Concrete Ships. Concrete Barge Specifications Show Many Unusual Features. Marine News, vol. 5, no. 3, Aug. 1918, pp. 70-71 and 122. Details of 21 vessels to be used on New York state barge canal system.

Concrete Ships, Harvey S. Owen. Jl. Engrs. Club of St. Louis, vol. 3, no. 4, July-Aug. 1918, pp. 243-255. Concrete ship designing problems; light aggregate and protective coating recently developed; opinions regarding durability of concrete ships.

Construction Features of Concrete Ships. Eng. & Contracting, vol. 50, no. 13, Sept. 25, 1918, pp. 303-304. The concrete; reinforcing steel; mixing and placing concrete; durability of a concrete ship. Abstract of paper by Rudolph J. Wig and S. C. Hollister before Amer. Concrete Inst.

Contruction of Concrete Ships for Emergency Fleet Corporation, R. J. Wig. Can. Engr., vol. 35, no. 9, Aug. 29, 1918, pp. 212 and 214. Principal characteristics of 3500-ton concrete ship. From special report to U. S. Shipping Board.

Developments in Concrete Barges and Ships, J. E. Freeman. Int. Mar. Eng., vol. 23, no. 9, Sept. 1918, pp. 520-522. Brief résumé of history of concrete shipbuilding; what has been accomplished in United States and abroad. From paper before Am. Concrete Inst., June 1918.

Ferro-Concrete Ships. Ferro-Concrete, vol. 10, no. 1, July 1918, pp. 7-17. Discussion of paper by T. J. Gueritte before North-East Coast Instn. of Engrs. & Shipbuilders, published in Apr. issue.

Method of Concrete Ship Construction, Theodore Ahlborn. Int. Mar. Eng., vol. 23, no. 9, Sept. 1918, pp. 517-520, 6 figs. Reinforcing diagrams of parts of the hull; methods of construction.

Reinforced Concrete Vessels, Walter Pollock. Int. Mar. Eng., vol. 23, no. 9, Sept. 1918, pp. 512-517, 9 figs. Discussion of factors involved in designing small coastwise concrete motorship. From paper before Instn. of Naval Architects, London, March 1918.

Eagles. Manufacturing Eagles at Ford Shipyard, Chas. Lundberg. Iron Age, vol. 102, no. 12, Sept. 19, 1918, pp. 679-684, 13 figs. Submarine chasers assembled on wheels and dropped into water; a launching a day the aim; general description of operation and plant.

Electrical Machinery. Electrical Application to Merchant Vessels, H. A. Hornor, Jl. Am. Soc. Naval Engrs., vol. 30, no. 3, Aug. 1918, pp. 490-503. General methods of installation in present practice; distribution, generating sets, switchfoards, lighting fixtures, search-lights and interior communication.

Fabricated Ships. Assembling and Regulating Ship's Structure T. L. Cohee. Int. Mar. Eng., vol. 23, no. 9, Sept. 1918, pp. 534-536. Rigid supervision and strict check and recheck system necessary to eliminate errors in assembling fabricated ships.

Control of Hull Construction of 5000-Ton Deadweight Fabricated Steel Vessel, "Fabricator". Int. Mar. Eng., vol. 23, no. 9, Sept. 1918, pp. 536-538. System employed at yard where straight work was produced at outside shops and furnaced work turned out at yard.

Industrial Management. Putting Our Merchant Ships on Schedule, L. P. Alford. Indus. Management, vol. 56, no. 3, Sept. 1918, pp. 227-230, 7 figs. How principles of industrial management have been applied in controlling ship movements.

Man Power. Manning the New Merchant Marine, Henry Howard. Int. Mar. Eng., vol. 23, no. 9, Sept. 1918, pp. 499-501. Free schools established for training deck and engine-room crews for American ships; details of system explained.

Training Workers for Wooden Shipyards. Int. Mar. Eng., vol. 23, no. 9, Sept. 1918, pp. 526-528, 4 figs. New course of instruction orgazined at Pratt Institute, Brooklyn, N. Y., for woodworkers in shipyards.

Oil Coolers. Multiwhirl Oil Cooler. Power, vol. 48, no. 14, Oct. 1, 1918, p. 489, 2 figs. Description of a watercooled oil-cooler through which oil to be cooled is pumped in a helical path so as to strike the water-filled tubes at right angles.

Passenger Steamers. Twin-Screw Passenger Steamer "Stavangerfjord." Engineering, vol. 106, no. 2746, Aug. 16, 1918, pp. 170-172, 21 figs. Deck plans, elevation, photographs and detailed description of features of the new 13,000-ton steamer built by Cammell, Laird & Co., Ltd., Birkenhead.

Shallow-Water Boats. Solving the Shallow Water Problem, W. V. Kidder. Motor Boat, vol. 15, no. 18, Sept. 25, 1918, pp. 13-14, 4 figs. Boat with flat "shovel" nose set in motion by air propeller in stern.

Standard Vessels. Further German Views on Standard Cargo Vessels, E. Goos. Shipbuilding & Shipping Rec., vol. 12, no. 10, Sept. 5, 1918, pp. 231-232, 1 fig. Considers that German yards, with possible exception of new yards recently built, have little to gain and much to lose by adopting policy of standard shipbuilding. From Schiffbau (Hamburg).

Welded Ships. Electrically Welded Cargo Ships. Jl. Engrs. Club of St. Louis, vol. 3, no. 4, July-Aug. 1918, pp. 203-210. Review of problems of welding in their application to marine construction and of work being done by U. S. Shipping Board, Emergency Fleet Corporation. From Nauticus (special supplement).

Evolution of Electric Welding Processes as Applied to Shipbuilding, H. A. Hornor, Jl. Engrs. Club of St. Louis, vol. 3, no. 4, July-Aug. 1918, pp. 256-263. Electric welding in railway shops; application to steel shipbuilding; British Admiralty investigation; experiments under way in the U. S.; electric welding methods. From Nauticus (special supplement).

Application of Electric Welding to Shipbuilding. Engineering, vol. 106, no. 2747, Aug. 23, 1918, pp. 197-199. Results of a six-months' series of tests and experiments carried out by Lloyd's. Also published in shipbuilding & Shipping Rec., vol. 12, no. 8, Aug. 22, 1918, pp. 186-188.

Electric Welding as Applied to Steel Ship Construction. Eng. & Contracting, vol. 50, no. 13, Sept. 25, 1918, pp. 308-309. Description of work of Electric Welding Committee of Emergency Fleet Corporation. General features of steamer; type of joints; method of assembly; amount of welding required. Also published in Jl. Engrs. Club of Phila., vol. 35-39, no. 166, Sept. 1918, pp. 427-428, and discussion pp. 428-439, 16 figs.

Welding. The Application of Electric Welding to Ship Construction and Repair. Elecn., vol. 81, no. 2102, Aug. 30, 1918, p. 379. A résumé of present practice.

METAL-WORKING TOOLS

Boring Machines. Defiance No. 5, Horizontal Boring, Milling, Drilling and Tapping Machine. Am. Mach., vol. 49, no. 11, Sept. 12, 1918, pp. 400-500, 1 fig. Description, with principal dimensions.

Overhead Flexible Boring Machine. Ry. Gaz., vol. 29, no. 6, Aug. 9, 1918, p. 160, 2 figs. Illustration of machine designed to meet demand for means of applying the Russell patent screwdriver to pieces of work which cannot be handled under spindle of an ordinary fixed drilling press. Also published in Practical Engr., vol. 58, no. 1640, Aug. 1, 1918, p. 51, 2 figs.

Gear-Cutting Machinery. The Works of the Moss Gear Co. Automobile Engr., vol. 8, no. 116, July 1918, pp. 203-210, 22 figs. Machines used and employed in factory specializing in manufacture of toothed gearing.

Millers. The Kempsmith "Maximiller" Am. Mach., vol. 49, no. 14, Oct. 3, 1918, pp. 595-600, 8 figs. Description of all-geared milling machine built by Kempsmith Mfg. Co., Milwaukee, Wis.

Milling Cutters. Grinding Relief of Milling Cutters. Machy., vol. 25, no. 1, Sept. 1918, pp. 9-10, 7 figs. Comparison of use of disk wheels and cup wheels for grinding milling cutters and an analysis of results obtained.

Nut-Forging Machine. Hollings Indenting Type of Nut-Forging Machine. Machy., vol. 25, no. 1, Sept. 1918, pp. 33-35, 5 figs. Machine wihch in conjunction with the special bar stock used makes it possible to produce well-formed blanks without excessive pressure and with a relatively small amount of scrap.

Pitch-Measuring Machine. Pitch Measuring Machine for Screw Gauges. Can. Machy., vol. 20, no. 11, Sept. 12, 1918, pp. 320-321, 2 figs. Features of Bingham Powell type.

Shell-Boring Lathe. "Galloway" Shell-Boring Lathe. Am. Mach., vol. 49, no. 12, Sept. 19, 1918, pp. 544-545, 1 fig. Illustration and principal dimensions.

Taps and Dies. Taps and Dies for Production Work, G. Doorakkers. Engineer, vol. 126, nos. 3269 and 3270, Aug. 23 and Aug. 30, 1918, pp. 151-152 and 186-187, 1 fig. (first and second articles), 5 figs.

Wrigglers. Wrigglers and Their Uses, Hugo F. Pusep. Am. Mach., vol. 49, no. 13, Sept. 26, 1918, pp. 559-560, 5 figs. Use of wrigglers in locating points on work to be drilled or milled when a fairly liberal tolerance is allowed.

MECHANICS

Balancing. The Balancing of Heavy Rotors, M. W. Torbert. Jl. Am. Soc. Naval Engrs., vol. 30, no. 3, Aug. 1918, pp. 518-533, 6 figs. Mathematical discussion of forces and couples based on six typical equations of motion.

Beams, Offset. The Design of Offset Beams, Victor M. Summa. Ry. Mech., Eng., vol. 92, no. 9, Sept. 1918, pp. 514-517, 9 figs. Discussion of formulæ used.

Rotation, Rapid. On the Determination of the Resistance to Motion of Rapidly Rotating Machines (Om bestammande af wastigt roterande maskiners rörelsemotstand), Erik Aug. Fursberg. Teknisk Tidskrift, vol. 48, no. 31, Aug. 3, 1918, pp. 385-389. (To be continued.)

Specific-Speed Method. Design of Water Propellers by the Specific Speed Method, Chas. F. Gross. Jl. Am. Soc. Naval Engrs., vol. 30, no. 3, Aug. 1918, pp. 534-546, 5 figs. Presents to draftsmen method of propeller design when given power propeller is to absorb and the speed of advance of propeller through water, items to be determined being diameter, pitch, mean width ratio and blade tickness.

Speed, Critical. Critical Speed in Tapered Shaft Design. Alfred Musso. Machy., vol. 25. no. 1, Sept. 1918, pp. 59-60, 1 fig. Derivation of formulæ and examples illustrating their use.

METAL ORES

Chromite. Chromite, J. C. Williams. Colo. School of Mines, vol. 8, no. 9, Sept. 1918, pp. 157-159. Foreign and domestic deposits; uses of chromium alloys; description of chromite; its occurrence and concentration.

Manganese. Pyrolusite from Virginia, Thomas L. Watson and Edgar T. Wherry. Jl. Wash. Acad. of Sci., vol. 8, no. 16, Oct. 4, 1918, pp. 550-560, 1 fig. Geology of manganese deposits and crystallography of ore.

Tungsten. Molybdenum, Tungsten and Bismuth. Ind. Australian & Min. Standard, vol. 60, nos. 1552, 1553, 1554, Aug. 8, 15 and 22, pp. 210-211, 245-247, and 284. Treatise on these minerals. Aug. 8: Molybdenite occurrences in Northern Europe, South America, and South Africa; geographical distribution of wulfenite. Aug. 15: list of wulfenite occurrences in United States. Aug. 22: occurrences of wultenite in Central and Southern Europe and Australasia.

METALLURGY

Aircraft. The Metallurgist and the Aircraft Program (III), H. F. Wood. Am. Drop Forger, vol. 4, no. 8, Aug. 1918, pp. 318-319. Suggestions on selection and testing of engine parts; responsibility of metallurgist on success of an airplane engine. From paper before Steel Treating Research Soc.

Tin. The Taylor Concentrator for Tin Slime, J. Waring Partington, Queensland Government Min. Jl. vol. 19, no. 219, Aug. 15, 1918, pp. 352-353 and 359-360, 3 figs. Consists of 24 rectangular concentrating surfaces attached to, and revolving with, a central vertical shaft, the latter being provided at its upper extremity with a worm gearing by means of which motion is imparted to frame. Machine designed in effort to eliminate disadvantages of usual type of revolving wooden round frame.

Wastes. Recuperation and Utilization of Wastes in the Manufacture of Copper, Zinc, Lead, Tin, Aluminum and Their Alloys (La récupération et l'utilisation des déchets de cuivre, zinc, plomb, étain, aluminum et de leurs alliages), Paul Razons. Génie Civil, vol. 73, nos. 9 and 10, Aug. 31 and Sept. 7, 1918, pp. 171-174, 8 figs., and pp. 184-188, 1 fig. Aug. 31: Apparatus for recuperating copper vapors in copper works; method of washing copper filings. Sept. 7: usage of copper waste in the manufacture of cupric sulphate; remelting of bronze filings; by-products of zinc works and recuperation of zinc from refuse of galvanised iron. (To be continued.)

Zinc. Electrothermal Metallurgy of Zinc (La métallurgie électrothermique du zinc), J. Escard. Génie Civil, vol. 73, nos. 7, 8 and 9, Aug. 17, 24 and 31, 1918, pp. 124-127, 3 figs., pp. 141-146, 9 figs., and pp. 168-171, 5 figs. Aug. 17: Coal-reduction methods, De Laval and Johnson furnaces. Aug. 24: Condensation of zinc vapors; decomposition of zinc sulphide by iron; industrial furnaces. Aug. 31: Results obtained with Côté and Pierron furnaces; Peterson's process; Thomson-Gerald furnace; Snyder furnace.

MILLWRIGHTING

Belt Clearances. Belt Clearances for Oblique Drives, F. R. Parsons. Nat. Engr., vol. 22, no. 9, Sept. 1918, pp. 419-420, 3 figs. Description of setting out floor clearances and difficulties encountered; hints on how to do such work correctly. From Mech. World.

Shafting. Aligning and Erecting Shafting (1). Ironmonger, vol. 164, no. 2338, Sept. 7, 1918, p. 42, 4 figs. Supplementing information in series on belt-driving practice published June 29, July 6, and Aug. 10.

MILITARY ENGINEERING

Artillery. Calculation of a Long Range Gun (Note sur le calcul d'un canon à longue portée). Génie Civil, vol. 73, no. 10, Sept. 7, 1918, pp. 191-192, 1 fig. Calculation of characteristics of trajectory for 100 km. range; mechanical requirements of projectile.

Contract Organization. Contract Organization Vitally Important for War Work, Francis Donaldson. Eng. News-Rec., vol. 81, no. 12, Sept. 19, 1918, pp. 535-538. Large-scale government construction demands most careful coördination of forces; charts setting forth organization of two typical contracts.

Electrical Machinery. Electrical Developments for American Army, R. K. Tomlin, Jr. Elec. World, vol. 72, no. 12, Sept. 21, 1918, pp. 532-536, 8 figs. Present plans for troops in France provide for 50,000 kw.; technical board controls supplies and coordinates work of design and construction; electrical machinery difficult to get.

Mine Safety Appliances. Mine Safety Appliances in Warfare, F. H. Trego. Coal Age, vol. 14, no. 11, Sept. 12, 1918, pp. 504-505. Account of mine safety appliances which have been adapted by War Department for use in war.

Railways, Military. Operation of the U. S. Military Railways in France, J. G. Porter. Ry. Age, vol. 65, no. 12, Sept. 20, 1918, pp. 549-551. How Americans adapted themselves to new transportation conditions encountered overseas.

Rifles. Temporary Small-Arms Repair Shop in France, R. K. Tomlin, Jr. Am. Mach., vol. 49, no. 12, Sept. 19, 1918, pp. 535-536, 3 figs. Description of repair shop for salvaging rifles.
The Science of the Rifle, F. H. Kelly. Arms & Explosives, vol. 26, no. 312, Sept. 2, 1918, pp. 117-120, 2 figs. Action of bolt magazine and trigger parts. From writer's book under same title.

Sanitary Engineering. Water Supply Fire Protection, Roads and Waste Disposal of a Large Training Camp, Murray Warner. Am. City, vol. 19, no. 3, Sept. 1918, pp. 174-176, 1 fig. Distribution system of water supply based on standard daily allowance of 55 gal. per man; machines used in the five fire stations; sewage and garbage disposal.

Arms. Revolvers and Automatic Pistols (Les revolvers et les pistolets automatiques), L. Cabanès. Génie Civil, vol. 73, nos. 8 and 9, Aug. 24 and 31, 1918, pp. 146-150, 7 figs., and pp. 165-167. Aug. 24: English Gabbett-Fairfax model; American Colt 38: characteristics of Colt 45. Aug. 31: Classification of various types in order of merit; choice of pocket pistol for personal defense in peace times; choice for war service; automatic Colt 45.

Substations. The Outdoor Substation in War Service, E. B. Meyer. Elec. World, vol. 72, no. 12, Sept. 21, 1918, pp. 537-541, 9 figs. Through its use the sudden demand for power to supply war industries has been promptly met with a resulting conservation of material and labor.

Supply Bases. Army Intermediate Depot in France, Problem in Getting Labor and Supplies, Robert K. Tomlin, Jr. Eng. News-Rec., vol. 81, no. 11, Sept. 12, 1918, pp. 478-483, 11 figs. Project covers site six miles long; three types of warehouses being built; Chinese labor used on railroad grading; installation completed for storing 5000 tons of beef at zero temperature.
Boston Army Supply Base Will be Valuable Permanent Port Terminal. Eng. News-Rec., vol. 81, no. 12, Sept. 19, 1918, pp. 522-526, 5 figs. Description of storage warehouse in Boston having 60 acres of storage space.

Troop Transportation. A Novel Scheme for Carrying Troops by Rail, Frederick C. Coleman. Ry. Age, vol. 65, no. 11, Sept. 13, 1918, pp. 509-511, 5 figs. The Great India Peninsula Railway of India's military cars, holding 66 soldiers each, described.
Military Trains in India. Ry. Gaz., vol. 29, no. 9, Aug. 30, 1918, pp. 232-236, 13 figs. Plans and interior arrangement of carriages.

MINES AND MINING

Asphalt. Asphalt Deposits and Oil Conditions in Southwestern Arkansas, Hugh D. Miser and A. H. Purdue. U. S. Geol. Survey, Bul. 691-J, Contributions to Economic Geology Part II, Aug. 16, 1918, pp. 171-292. 1 fig. Geography and geology; general features and local details of asphalt deposits; drilling for oil; well records.

Blackdamp. Outbursts of Gas in Crowsnest Field, James Ashworth. Coal Age, vol. 14, no. 10, Sept. 5, 1918, pp. 443-446, 3 figs. Description of violent gas outbursts which have caused coal fields to be shut down; theories advanced to account for outbursts; suggestions for proceeding with work. Abstract of pamphlet entitle Outbursts of Explosive Gases in the Crownest Pass Coalfield, British Columbia.
The Origin of Blackdamp, J. I. Graham. . Trans. Instn. Min. Engrs., vol. 55, part 4, Aug.-Sept. 1918, pp. 303-312. Experiments from which author formulates four ordinary compositions of blackdamp resulting from different contributory causes.

Briquetting of Ores. Briquetting of Powdery Ores and of Blast Furnace Dust (Le briquetage des minerais pulvérulents et des poussières de hauts fourneaux.) Génie Civil, vol. 73, no. 7, Aug. 17, 1918, pp. 131-134, 10 figs. Schumacher process; Fawcet, Sutcliffe and Speakman presses; nodulation and agglomeration processes.

Cementation. The François Cementation Process, A. H. Krynauw. Min. Mag., vol. 19, no. 2, Aug. 1918, pp 68-77, 10 figs. Cases in which cement grout under pressure has been successfully applied and manner in which this has been done. From paper before Chem., Metallurgical, and Min. Soc. of So. Africa.

Explosives. Some Notes on Experiments Made with a View to Reducing the Consumption of Explosives, and Increasing the Fathoms Broken per Machine Shift in Machine Stoping, T. H. Bayldon, Jl. So. African Instn. Engrs., vol. 16, no. 12, July 1918, pp. 226-233, 2 figs. Tables comparing two methods: (1) drilling alternately on two stope faces and doubling size of benches, (2) cutting four three-hole benches for each machine on each face.

Manganese. Manganese Deposits of East Tennessee. The Resources of Tennessee, vol. 8, no. 3, July 1918, pp. 153-207, 10 figs. Report of results of field work by geologists of U. S. Geol. Survey in co-operation with the State Geol. Survey of Tennessee; geography of region; manganese minerals; rocks with which ore is associated; types of deposits; description of typical mines and prospects.

Man Power. Mechanical Equipment and the Conservation of Miners, R. L. Herrick. Compressed Air Mag., vol. 23, no. 9, Sept. 1918, pp. 8876-8881, 7 figs. Typical examples of man power savings observed by writer on a 450-mile automobile trip about the mines in the anthracite district.

Salt. Salt Mining and Dressing, J. B. Calkins. Eng. & Min. Jl., vol. 106, no. 10, Sept. 7, 1918, pp. 431-435, 7 figs. Brief history of salt industry, with detailed account of mining and milling operations at a property in New York State having an output of 2000 tons of prepared salt in a 10-hr. day; details as to haulage, dressing and mechanical treatment.

Shale Oil. The Extraction of Oils from Shales and Coal. Petroleum Rev., vol. 39, no. 836, July 27, 1918, p. 59. New English patented process consisting in mixing powdered shale or coal both with some finely ground material (such as limestone, dolomite, carbonate of magnesium or barium carbonate), which, under the action of heat, will give off carbonic acid gas, and with small iron scrap (such as iron turnings) or its chemical equivalent for the purpose of causing the release of increased quantities of hydrogen.

MOTOR-CAR ENGINEERING

Chassis. Military Transport Chassis (VII). Automobile Engr., vol. 8, no. 118, Sept. 1918, pp. 267-270, 4 figs. Details of F. W. D. (Model B) 3-ton chassis.

Fuels. The Valuation of Motor Fuels, Harold Moore. Automobile Engr., vol. 8, no. 118, Sept. 1918, pp. 245-248. Relative value of tests: specific gravity, viscosity, cold test, coke test, fractional distillation, specific heat, iodine and bromine values, ultimate analysis, temperature of spontaneous ignition, explosive range, calorific power.
Use of Gas for Automobiles. Gas Age, vol. 42, no. 5, Sept. 2, 1918, pp. 199-200. French discussion upon intensive trials both in England and France made with automobiles driven with illuminating gas.

Gear Changing. A Mechanism for Changing Gears Automatically. Automotive Ind., vol. 39, no. 10, Sept. 5, 1918, pp. 416-417, 4 figs. Gears shifted and clutch operated by engine power.
The Problem of the Gear Box. Auto, vol. 23, no. 35, Aug. 30, 1918, pp. 625-626. Inquiry of conditions limiting possibilities in design. (To be continued.)

Racing Cars. The 300 H.P. Fiat Racer. Autocar, vol. 41, no. 1189, Aug. 3, 1918, pp. 117-118, 1 fig. Dimensions and history.

Spark Plugs. How Automobile Spark Plugs Are Made. Commercial America, vol. 15, no. 3, Sept. 1918, pp. 33-37, 7 figs. Cold-drawing and automatic machine process; making porcelain; experimenting; testing and assembling.

STEERING. Problems in Steering of Motor Cars Discussed from the Point of View of Projective Geometry (Anwendung eines Satzes der projektiven Geometrie auf die Lenkung von Automobilen. C. Veithen. Dingler's Polytechnisches Journal, vol. 333, no. 2, Jan. 26, 1918, pp. 9-10, 3 figs.

THREE WHEEL CARS. The Morgan Runabout. Autocar, vol. 41, no. 1189, Aug. 3, 1918, pp. 123-124, 4 figs. Brief description of a three-wheeled light car.

TRAILERS. Development of the Trailer. Sibley Jl. of Eng., vol 32, no. 12, Sept. 1918, pp. 180-183, 2 figs. Experimental basic trailing laws; steering.

VALVE DESIGN. Four Valves per Cylinder. Autocar, vol. 41, no. 1195, Sept. 14, 1918, p. 264. Six-cylinder Pierce Arrow engine with 12 inlet and 12 exhaust valves in one pocket.

MUNICIPAL ENGINEERING

CATCH BASIN CLEANING. Catch Basin Cleaning in Chicago. Mun. Jl., vol. 45, no. 11, Sept. 14, 1918, pp. 199-200. Itemized costs of work done by hand and by auto-educator, time of cleaning different basins.

CITY PLANNING. The Planning of the New Halifax, Thos. Adams. Contract Rec., vol. 32, no. 35, Aug. 28, 1918, pp. 680-683, 3 figs. Plans and details of six schemes, two for city and four for county.
The St. Louis Zone Plan, Harland Bartholomew. Jl. Engrs. Club of St. Louis, vol. 3, no. 4, July-Aug. 1918, pp. 214-240, 5 figs. Provisions of city building zone plan passed by Board of Aldermen.

SALVAGE. Municipal Salvage, J. C. Dawes. Surveyor, vol. 54, no. 1390, Sept. 6, 1918, pp. 111-112. Possibilities of utilizing ordinary house refuse. Inst. of Cleansing Superintendents. (To be concluded.)

STREET LIGHTING. The Aesthetics of Street Lighting, M. Luckiesh. Trans. Illuminating Eng. Soc., vol. 13, no. 6, Aug. 30, 1918, pp. 355-356. Abstract of paper before Phila. Section of the Soc.

MUNITIONS

CANADA. Canada's Production of Munitions of War. Can. Min. Jl., vol. 39, no. 17, Sept. 1, 1918, pp. 295-296. Summary of work of Imperial Munitions Board, with a few details regarding most important departments.

EXPLOSIVES. Sengite: A New Explosive, J. P. Udal. South African Min. Jl., vol. 27, part 2, no. 1401, Aug. 3, 1918, p. 307. Process of manufacturing explosive made of gun coton impregnated with nitrate of soda.

FUSES. Making the Mark III Detonating Fuse. Edward K. Hammond. Machy., vol. 25, no. 1, Sept. 1918, pp. 27-32, 9 figs First of a series describing operations involved.

GUNS. Lathes for the Present Gun Program, A. L. De Leeuw. Am. Mach., vol. 49, no. 11, Sept. 12, 1918, pp. 491-493. Suggestions for obtaining at once required lathes for manufacture of guns.
The British 6-Inch Howitzer, I. W. Chubb. Am. Mach., vol. 49, no. 14, Oct. 3, 1918, pp. 605-612, 16 figs. Body and breach mechanism; various turning, boring, rifling and planing operations are described. (Third article.)

HELMETS. Ancient Helmet Making, H. H. Manchester. Am. Mach., vol. 49, no. 12, Sept. 19, 1918, pp. 503-507, 28 figs. A résumé of art of making helmets from earliest times.

MACHINE GUNS. The Manufacture of the Lewis Machine Gun, Frank A. Stanley. Am. Mach., vol. 49, no. 12, Sept. 19, 1918, pp. 529-531, 9 figs. Thirteenth article describing manufacture of Lewis machine gun. Second article on the barrel, describing chambering, lapping and inspection.

SHELLS. Government Requires Millions of Gas Shells. Foundry, vol. 46, no. 10, Oct. 1918, pp. 441-442. Program of Government for next twelve months.
Rectifying Rough Bored 155-mm. Shells, M. P. Potter. Can. Machy., vol. 20, no. 9, Sept. 5, 1918, p. 297, 5 figs. Type of head developed after Government requirements.
Making the U. S. 8-in. Shell, M. E. Hoag. Am. Mach., vol. 49, nos. 11 and 12, Sept. 12 and 19, 1918, 9 figs, and 457-460, 11 figs. Describes turning and boring. (Series of articles.)

Labor-Saving Washing Device Used on Shell Work, J. H. Rodgers. Can. Machy., vol. 20, no. 9, Sept. 5, 1918, p. 299. Arrangement by which shells are subjected to a spray wash of soda solution, followed by a rinsing with clear hot water.

PHYSICS

AIR. Physics of the Air, W. J. Humphreys. Jl. Franklin Inst., vol. 186, no. 3, Sept. 1918, pp. 341-370, 6 figs. Discussion of crushing of hollow conductors by lightning discharges; quantity of electricity in discharge; general rules for construction of an efficient system of lightning protection; electrical field of the earth; electrical conductivity of the atmosphere; ionic content of the air. (Continuation of serial.)

LUMINOUS MATERIALS. On the Luminescence Due to Radio-Activity, Enoch Karrer and D. H. Kabakjian. Jl. Franklin Inst., vol. 186, no. 3, Sept. 1918, pp. 317-340, 17 figs. Quantitative data on rejuvenation of self-luminous materials, and in particular of radium bromide.

PIPE

CORROSION PREVENTION. The Deactivator System for Elimination of Corrosion in Hot Water Supply Pipes. Eng. & Contracting, vol. 50, no. 13, Sept. 25, 1918, pp. 297-299, 1 fig. Description of an experimental plant installed in an apartment house in Boston and results obtained. Installation made by Research Laboratory of Applied Chemistry, Massachusetts Institute of Technology in co-operation with Research Department of National Tube Co.
Discussion Concerning the Destruction of Gas and Water Piping in Clayey Soils Containing Gypsum (Zur Zerstörung der Gasund Wasserleitungen in gipshaltigem Lehmboden), P. Medinger. Journal für Gasbeleuchtung, year 61, nos. 7 and 8, Feb. 16 and 23, 1918, pp. 63-76, 1 fig., and pp. 89-91, 3 figs. Extensive discussion of the underlying chemical phenomena.

WOOD. Redwood Pipe and Its Uses. Eng. & Cement World, vol. 13, no. 7, Oct. 1, 1918, p. 32, 1 fig. Processes of making three principal types in present use.

POWER GENERATION AND SELECTION

COAL MINING. Electricity in Coal Mining Operations, Frank Huskinson. Elec. World, vol. 73, no. 13, Sept. 28, 1918, pp. 494-495. Mine signaling and telephone systems; data on rope haulage; miscellaneous applications.
The Electrification of a Durham Colliery. Engineer, vol. 126, no. 3268, Aug. 16, 1918, pp. 136-138, 4 figs. Description of electrical equipment of a British colliery.

COMBINED POWER. Economic Proportion of Hydro-electric and Steam Power, Frank G. Baum. Elec. Rev., vol. 73, no. 12, Sept. 21, 1918, pp. 450-451, 2 figs. New method of determining economical proportion of hydro-electric to steam power. From paper before Am. Inst. of Elec. Engrs.

EFFICIENCY. Efficiency in Power Production, M. T. Borja. Aera, vol. 7, no. 2, Sept. 1918, pp. 175-177, and (discussion) pp. 177-178. Suggestions to engineers. (Manila Elec. Ry. & Light Co.)

ELECTRICITY. Industrial Applications of Electricity, Dwight D. Miller. Elec. Contractor-Dealer, vol. 17, no. 12, Oct. 1918, pp. 123-128, 2 figs. Examples of uses of electric heat; advantages of electric drive-friction losses, greater output for a given time, flexibility of operation, lighter builting construction, safety.

EXHAUST STEAM. Utilization of Exhaust Steam in Collieries for the Production of Electrical Energy. (Considérations sur l'utilisation des Vapeurs d'échappement dans les houillères en vue de la production d'énergie électrique), A. Barjou. L'Indusdustrie Electrique, year 27, no. 628, Aug. 25, 1918, pp. 308-312, 5 figs. Diagram and formula to determine steam consumption of low-pressure turbines: scheme of connections for a turbo-alternator group. 625 kva. 5000 volts. (Continuation of serial; former installments in no. 621, p. 166, no. 623, p. 212, and no. 627, p. 287.

MINING. Electricity in Mining, L. Fokes. Sci. & Art of Min., vol. 29, no. 2, Aug. 24, 1918, pp. 18-20, 5 figs. Safe operation of signaling apparatus; signaling circuits. (Continuation of serial.)

MOTOR SELECTION. Applying Engineering Principles Properly in Motor Selection, C. W. Squier. Elec. Ry. Jl., vol. 52, no. 12, Sept. 21, 1918, pp. 505-508, 14 figs. How to compare electric motors which appear to have the necessary characteristics for service designated and to select the one best adapted to meet given requirements.

OILFIELDS. The Application of Electrical Power to Oilfield Requirements, J. Wilfred Burford. Jl. Instn. Petroleum Technologists, vol 4, no. 16, June 1918, pp. 229-262, 4 figs., and (discussion) pp. 262-276. Economics gained by installation of electrical machinery; requirements of petroleum-producing industry; field this industry offers to manufacturers of electrical machines.

PRINTING. Electrically-Driven Printing Presses. Engineer, vol. 126, no. 3268, Aug. 16, 1918, 9 figs. Illustrations of arrangements and controllers; wiring diagrams.

POWER INDUSTRY. Conditions in the Power Industry, L. W. Schmidt. Power, vol. 48, no. 14, Oct. 1, 1918, pp. 486-488. Digest of reports of United States consuls on power situation in various parts of world and influence of war upon this industry.

WATER WORKS. Electric Drive for Water Works (Der elektrische Antrieb von Wasserversorgungsanlagen), Wintermeyer. Journal für Gasbeleuchtung, year 61, nos. 11 and 12, Mar. 16 and 23, pp. 126-128, 6 figs., and pp. 137-142, 10 figs. Discussion with diagrams of motor-generator connections.

WIND POWER. The Use of Wind Power (Om udnyttlese af yindkraften), H. C. Vogt. Ingenioren, vol. 27, no. 65, Aug. 14, 1918, pp. 451-452, 2 figs. (Continued from June 8.)

POWER PLANTS

AUXILIARIES. Motor-Driven Auxiliaries, C. Grant. Mech. World, vol. 64, nos. 1648 and 1651, Aug. 2, and Aug. 23, 1918, pp. 52-53, and p. 88. Aug. 2: Rotary air-pumps; circulating pumps. Aug. 23: Remarks on operation of feed pumps; chimney draft fans; generator cooling fans.

CEDAR RAPIDS, STEAM. Cedar Rapids Big Steam Plant. Power, vol. 48, no. 14, Oct. 1, 1918, pp. 478-485, 13 figs. Description of 16,000-kw. steam-turbine plant, with list of principal equipment.

CHIMNEYS. Graphic Method of Chimney Design, H. M. Brayton. Power vol. 48, no. 10, Sept. 3, 1918, pp. 349-350, 3 figs. Method of designing chimneys without calculations by use of charts and curves.
Rusting Steel Chimneys Coated with Concrete by Cement Gun. Eng. News-Rec., vol. 81, no. 13, Sept. 26, 1918, pp. 596-597, 3 figs. Reinforcer-concrete shell is applied to outside of steel stacks.

CINCINNATI, STEAM. Cincinnati's New 100,000-Kilowatt Power Station. Elec. Rev., vol. 73, nos. 11 and 12, Sept. 14 and 21, 1918, pp. 397-400, 5 figs., and pp. 439-441, 5 figs. First installment describing station layout and mechanical equipment of Union Gas & Electric Company's new station with initial capacity of 50,000 kilowatts. Also published in Power, vol 48, no. 10, Sept. 3, 1918, pp. 337-344, 14 figs.

ENGINE HOUSE. Rectangular Engine House Avoids Use of Turntable. Eng. News-Rec., vol. 81, no. 13, Sept. 26, 1918, pp. 593-594, 3 figs. Reinfroced-concrete building has arched roof on timber lattice trusses; engine stalls have swinging doors.

FEEDWATER HEATER. The Swartwout Feed-Water Heater and Receiver. Steam, vol. 22, no. 3, Sept. 1918, p. 80, 1 fig. Automatic apparatus designed to heat feedwater by use of exhaust steam.

FLEXIBILITY. Flexibility of Industrial Power Plants, Southern Engr., vol. 30, no. 2, Oct. 1918, p. 57, 1 fig. Typical connection diagram utilizing rotary converters for tying alternating and direct-current generators together.

[illegible] Management of the Power Plant, Robert June. [illegible] 1918, pp. 77-81, 5 figs. [illegible] purpose of [illegible]

[illegible] Power, vol. 48, no. 11, Sept. 10, 1918, [illegible] Some instances of [illegible] equipment [illegible]

[illegible] of Power Plant Inspection and Coal Conservation, [illegible] 48, no. 9, Aug. 27, 1918, pp. 302-[illegible] An [illegible] Massachusetts.

[illegible] More Energy for Mansfield District. Power Plant Eng., vol. 22, no. 18, Sept. 15, 1918, pp. 733-738, 12 figs. Description of new plant of Mansfield Electric Light & Power Co. at Melco, Ohio, using [illegible]

[illegible] New Hydro-electric Plant of Montana Power Company, W. A. Scott. Elec. Rev., vol. 73, no. 13, Sept. 28, 1918, pp. 487-490, 2 figs. Details of recently completed Holter project.

Pennsylvania Salt Co., Steam. New Plant of the Pennsylvania Salt Manufacturing Company. Power, vol. 48, no. 12, Sept. 17, 1918, pp. 406-413, 10 figs. Description of a modern steam-turbine alternating-current plant with rotary-converter transformation to direct-current for electrolytic work.

Records. Power Plant Records of Operation, Ralph E. Turner. Power Plant Eng., vol. 22, no. 19, Oct. 1, 1918, pp. 799-803, 4 figs. Report sheets designed to aid engineer in obtaining and maintaining highest efficiency.

Rochester, Hydro-electric. Hydro-electric Development at Rochester. Power Plant Eng., vol. 22, no. 19, Oct. 1, 1918, pp. 779-782, 8 figs. Description of features of an hydro-electric plant.

Vibration. Prevention of Vibration in Power and Ventilation Plants, Charles L. Hubbard. Power Plant Eng., vol. 22, no. 19, Oct. 1, 1918, pp. 782-785, 11 figs. Causes of vibration and forms of foundations, supports, hangers and connections to prevent communication to building structure.

PUMPS

Motor-Driven Pumps. Motor-Driven Pumps, Chas. Lawson. Southern Engr., vol. 30, no. 2, Oct. 1918, pp. 66-73, 6 figs. Pumping data; lift of pumps and pump control.

Triplex Pumps. Triplex Pumps, John H. Perry. Domestic Eng., vol. 84, no. 8, pp. 275-276 and 306, 4 figs. A few of the different kinds and how they work.

RAILROAD ENGINEERING, ELECTRIC

Circuit Breakers. High-Speed Circuit Breakers for Chicago, Milwaukee & St. Paul Electrification, C. H. Hill. Gen. Elec. Rev., vol. 21, no. 9, Sept. 1918, pp. 623-626, 5 figs. Details of construction.

Cripples. The Disabled Soldier in Electric Railway Service. Electric Ry. Jl., vol. 52, no. 13, Sept. 28, 1918, pp. 579-582, 10 figs. Reclaiming the disabled soldier; blind men winding coils; one-armed men doing shop work.

Freight Transportation. The Problem of Freight Haulage, Harlow C. Clark. Aera, vol. 7, no. 2, Sept. 1918, pp. 103-106. Summary of electric railway freight situation in its connection with national transportation; causes preventing use of many miles of available track.

Locomotives. Advantages of Storage-Battery Locomotives C. W. Chappelle. Coal Age vol. 14, no. 10, Sept. 5, 1918, pp. 437-442, 3 figs. Paper read before Illinois Min. Inst., Peoria, Ill., May 1918, and discussion which followed.

Determination of the Proper Size of Storage-Battery Locomovite, Dever C. Ashmead. Coal Age, vol. 14, no. 12, Sept. 19, 1918, pp. 548-552, 2 figs. Explaining calculations of draw-bar pull and battery capacity.

Electric Shunting Locomotive, Lancashire & Yorkshire Ry. Ry. Gas, vol. 29, no. 9, Aug. 30, 1918, p. 237, 1 fig. Particulars of an electric locomotive designed for shunting service at Clifton power station.

Rewinding and Testing Direct-Current Locomotive Armatures, Frank Huskinson. Coal Age, vol. 14, no. 12, Sept. 19, 1918, pp. 541-544, 16 figs. How mine-locomotive armatures may be rewound.

RAILROAD ENGINEERING, STEAM

Ballasting. A Typical Rock Ballasting Organization, F. H. C. Graves. Ry. Maintenance Engr., vol. 14, no. 9, Sept. 1918, pp. 310-311, 1 fig. Account of work done recently on a double-track eastern road with dense traffic.

Bolsters. Effect of Holes in the Sides of Box Bolsters, L. E. Endsley. Ry. Mech. Eng., vol. 92, no. 9, Sept. 1918, pp. 507-508, 3 figs. Results of a series of tests made on a box bolster with and without holes in the sides.

Brakes. Brake Performance with Heavy Trains. Ry. Gaz., vol. 29, no. 10, Sept. 6, 1918, p. 254. Remarks upon requirements of an efficient brake system based upon results obtained by the Virginian Ry. and described in same issue.

Car Cleaning. Passenger Car Cleaning on the Canadian Pacific Railway, E. Eley. Can. Ry. & Marine World, no. 248, Oct. 1918, p. 432. Description of process. Paper before Can. Ry. Club, Montreal.

Car Lighting. Lighting of Railroad Cars by Coal Gas (Die Beleuchtung der Eisenbahnwagen mit Steinkohlengas), O. Hübner. Dingler's Polytechnisches Journal, vol. 333, no. 2, Jan. 26, 1918, pp. 10-12. From Journal für Gas-[illegible] pp. 117-125 and 135-139. Abstract of an extensive paper.

Cars, Passenger. New Cars for Special and Excursion Traffic. Ry. Gaz., vol. 29, no. 6, Aug. 9, 1918, pp. 159-160, 3 figs. General design of 26-ton, 82-passenger car prepared for Victorian Railways.

Cars, Standard. Railroad Administration's Standard Baggage Cars. Ry. Age, vol. 65, no. 13, Sept. 27, 1918, pp. 584-586, 3 figs. Details of designs for 60-ft. and 70-ft. cars of all-steel construction.

Steel Baggage Car for the United States Railroad Administration. Ry., Rev., vol. 63, no. 10, Sept. 7, 1918, pp. 341-343, 4 figs. General description of design adopted for all-steel 70-ft. baggage cars.

Cars, Wooden. Large Capacity Wooden Hopper Car. Ry. Mech. Eng., vol 92, no. 9, Sept. 1918, pp. 509-512, 3 figs. Drawings and general data with description of wooden hopper car built by the N. & W.

Cranes. Gasoline Travelling Crane for Railroad Ash Pits. Ry. & Locomotive Eng., vol. 31, no. 10, Oct. 1918, pp. 305-307, 4 figs. General features of machines used by New York Central.

Draft Gear. Proper Draft Gear Maintenance, L. T. Canfield. Ry. Rev., vol. 63, no. 13, Sept. 28, 1918, pp. 460-462, 2 figs. Report of five tests of gears; recommendations as to inspection and repair. Paper read before Car Foreman's Assn. of Chicago, Sept. 1918.

Firing. Mechanical Stoking of Locomotives as Related to Smoke, W. S. Bartholomew. Ry. Rev., vol. 63, no. 10, Sept. 7, 1918, pp. 339-341. Résumé of stoker firing practice citing general points of advantage over hand firing, as well as specific instances in support of these claims. Read before Smoke Prevention Assn. at Newark, N. J., Aug. 22.

Freight Handling. The Mechanical Handling of Goods on Railways. Ry. Gaz., vol. 29, no. 10, Sept. 6, 1918, pp. 258-261, 14 figs. Handicaps imposed by wartime conditions on handling railway goods to rail truck from trader or Government consignee and vice versa.

Locomotives. Locomotive Stokers and Smoke Prevention, W. S. Bartholomew. Ry. Age, vol. 65, no. 10, Sept. 6, 1918, pp. 451-453. Résumé of stoker firing practice citing general points of advantage over hand firing, as well as specific instances in support of these claims. Read before Smoke Prevention Assn., Newark, N. J., Aug. 22.

Locomotive Terminal Detention Records. Ry. Gaz., vol. 29, no. 9, Aug. 30, 1918, pp. 241-242. Forms used by the Pennsylvania for gathering information regarding locomotive delays at terminals.

Making Good Engines Better on the Delaware Lackawanna and Western. Ry. & Locomotive Eng., vol. 31, no. 10, Oct. 1918, p. 319, 3 figs. Results obtained from engines fitted with " Universal " steam chests and valves.

Renewable Stayheads for Locomotive Fire-boxes. Engineer. vol. 126, no. 3270, Aug. 30, 1918, pp. 176-177, 5 figs. Description of a new renewable staybolt head and report of experiments and tests made upon it.

Results of Road Tests of N. & W. Mallet Locomotive, H. W. Reynolds. Ry. Mech. Eng., vol. 92, no. 9, Sept. 1918, pp. 502-503, 3 figs. General data on boiler, engine and locomotive performance, and results of tests.

Superheater Locomotive Performance. Ry. Age, vol. 65, no. 11, Sept. 13, 1918, pp. 498-499, 1 fig. Importance of maintenance; clean flues; dampers; effects of high water; lubrication and drifting.

Ten-Wheel and Mikado Type Locomotives for the Paris-Orleans Ry., F. C. Coleman. Ry. Rev., vol. 63, no. 8, Aug. 24, 1918, pp. 267-268, 2 figs. Description of two designs of locomotives recently introduced into heavy freight and passenger service in France.

Terminal Handling of Locomotives, H. C. Pickard. Can. Ry. & Marine World, no. 248, Oct. 1918, pp. 421-424, 11 figs. Suggestions regarding conservation of man power in cleaning fires in locomotives.

The Design and Uses of Tank Locomotives. Ry. Gaz., vol. 29, no. 6, Aug. 9, 1918, pp. 161-164, 6 figs. Claimed advantages of tank locomotives. Diagram drawings of the 0-6-4, 2-6-4, 4-6-2, 4-4-4 and 4-6-4 types.

Locomotives, Standard. Heavy Mikado Type Locomotive United States Railroad Administration. Ry. Rev., vol. 63, no. 10, Sept. 7, 1918, pp. 331-334, 5 figs. Descriptive reference to first of heavy Mikado type locomotives to be constructed for U. S. R. R. Administration Comparison with leading details of light Mikado type.

Heavy Standard Mikado Locomotive. Ry. Mech. Eng., vol. 92, no. 9, Sept. 1918, pp. 491-494, 7 figs. General description and principal data, with drawings.

Tonnage Rating of the Standard Locomotives, H. S. Vincent. Ry. Age, vol. 65, no. 14, Oct. 4, 1918, pp. 627-631, 3 charts. Charts of tonnage rating for U. S. Standard light Mikado, heavy Mikado and 8-wheel switching locomotives, with tables of frictional resistances of freight and passenger cars.

The U. S. Standard Heavy Mikado Type Locomotive. Ry. Age, vol. 65, no. 9, Aug. 30, 1918, pp. 375-376, 4 figs. General description, with drawings and principal data.

Rails. On the Stiffness and Relative Strength of Rails, E. W. Stoney. Indian Eng., vol. 63, no. 22, June 1, 1918, p. 304, 6 figs. Diagrams showing plots of results of experiments on deflection of rails in various positions by central dead loads.

Transverse Rail Fissues and the Derailment at Juniper, Ga. Ry. Rev., vol. 63, no. 9, Aug. 31, 1918, pp. 305-309, 9 figs. From report of engineer-physicist of Bureau of Safety, Interstate Commerce Commission, on failure by breaking in several places of a 12-year old 80-lb. A. S. C. E. section rail.

Salvage. Reclamation on the Southern Pacific, Frank A. Stanley. Ry. Mech. Eng., vol. 92, no. 9, Sept. 1918, pp. 505-506, 5 figs. Second installment. Description of extensive salvage work.

Shocks in Trains. Shocks in Long Passenger Trains, Robert Burgess. Southern & Southwestern Ry. Club, vol. 14, no. 10, July 1918, pp. 4-20 and (discussion) pp. 20-31. Causes producing them; suggestions to engine men.

Signals. Train Operation by Signal Indication on the Erie Railroad, Henry M. Sperry. Ry. Gaz., vol. 29, no. 9, Aug. 30, 1918, pp. 227-231, 4 figs. Summary of disadvantages experienced under manual block and improvement in train operation under automatic block. From the Railway Age.

Sleepers. The Green-Moore Patent Resilient Reinforced Concrete Sleepers. Ry. Gaz., vol. 29, no. 10, Sept. 6, 1918, pp. 262-264, 10 figs. Figures and illustrations. Other concrete sleepers have been described in issues of May 13 and July 19, 1918.

Snow. Maintaining a Railroad Above the Clouds. Ry. Maintenance Engrs., vol. 14, no. 9, Sept. 1918, pp. 291-295, 9 figs. Problems encountered in handling snow and ice to keep open the Moffatt line reaching an elevation of over 11,000 ft.

The Southern Pacific's Snow Shed Problem, Geo. W. Rear. Ry. Gaz., vol. 29, no. 6, Aug. 9, 1918, pp. 158-159. Brief history of development of 29 miles of snow sheds and of problems involved in their maintenance. From Proc. Am. Ry. Bridge & Building Assn., 1917.

SUPERHEATERS. Superheater Unit Maintenance. Ry. Rev., vol. 63, no. 13, Sept. 28, 1918, pp. 479-482, 9 figs. Instructions for installation and care of superheater units. From Bulletin No. 4, of Locomotive Superheater Co., New York.

TERMINALS. Unit Operation of Railroad Terminals. Ry. Rev., vol. 63, no. 13, Sept. 28, 1918, pp. 455-458. From Preliminary Report of Committee on Yards and Terminals, Am. Railway Eng. Assn., issued in Bulletin 208.

YARDS, GRAVITATION. Colwick Gravitation Yards, Great Northern Ry. Ry. Gaz., vol. 29, no. 7, Aug. 16, 1918, pp. 185-188, 5 figs. Plan and view of yard instituted for concentrating and remarshalling coal traffic to and from Notts and Derby mines.

REFRACTORIES

BRICK, INSPECTION. Inspecting Refractory Brick, C. L. Nesbitt and L. M. Bell. Iron Age, vol. 102, no. 11, Sept. 12, 1918, p. 630. Standard specification a necessity; results of some tests. From a paper before Am. Soc. for Testing Materials, June 1918.

BRICK, SILICA. The Manufacture of Silica Brick, H. Le Chatelier and B. Bogitch. Bul. Am. Inst. Min. Engrs., no. 141, Sept. 1918, pp. 1335-1462, 14 figs. Experiments on samples of a few grams conducted at the Sorbonne, Paris, for the purpose of determining necessary conditions in manufacture of high grade brick.

HIGH-TEMPERATURE RESEARCH. High Temperature Processes and Products (III), Chas. A. Darling. Jl. Royal Society of Arts, vol. 66, no. 3433, Sept. 6, 1918, pp. 649-656, 2 figs. Alundum and aloxite; artificial graphite: British processes: high-temperature research.

STRUCTURE. The Importance of Structure in Refractories, F. H. Kirkpatrick. Clay-Worker, vol. 70, no. 2, Aug. 1918, pp. 137-139, 6 figs. Effect of structure on the utimate quality of manufactured product. From the Effect of Size of Grog in Fire Clay Bodies, tech. paper 104, Bureau of Standards.

VOLATILIZATION. Relative Volatilities of Refractory Materials, Wm. Roy Mott. Gen. Meeting Am. Electrochem. Soc., Oct. 2, 1918, Advanced Copy, Paper 1 pp. 1-34, 6 figs. Experimental study of order in which substances volatize in electric arc, distances at which their vapors condense from arc, and time to volatilize equal atomic quantities of elements or molecular quantities of compounds; theoretical considerations concerning ratios of absolute boiling points to melting points, and upon a universal vapor pressure curve applicable to all substances.

REFRIGERATION

ICE MAKING. Modern Raw Water Ice Making Plant. Ice & Refrigeration, vol. 55, no. 1, July 1, 1918, pp. 1-6, 9 figs. Details of motor-driven 100-ton plant with complete equipment.

MULTIPLE-EFFECT COMPRESSION. Multiple-Effect Compression Ice-Making and Refrigerating Machines. Engineering, vol. 106, no. 2747, Aug 23, 1918, pp. 201, 7 figs. Diagram showing working cycle, indicator cards, and general description of a CO_2 multiple effect compression refrigerating machine built by Seagers, Limited, Dartford, Kent.

STORAGE-ROOM REFRIGERATION. Efficiency in Engineering, Eric H. Peterson. Ice & Refrigeration, vol. 55, no. 1, July 1, 1918, pp. 9-11, 5 figs. Charts showing refrigeration required for various temperatures in well-ventilated rooms and amount of pipe required for storage rooms.

ROADS AND PAVEMENTS

CONCRETE ROADS. A Road Finisher That Produces Denser Concrete. Eng. & Cement World, vol. 13, no. 4, Aug. 15, 1918, p. 33, 1 fig. Device designed in 1913 by E. G. Carr, said to eliminate voids in concrete, and to have been used in construction of 400 miles of California's highways.

Pavement Planer Method of Finishing Concrete Roads, E. Earl Glass. Eng. & Contracting, vol. 50, no. 14, Oct. 2, 1918, pp. 318-319, 4 figs. Description of tools and methods used in making a Concrete road in California.

CORNERS. Width of Roadway and Corner Cut-Off, R. H. Whitten. Mun. Jl., vol 45, no. 9, Aug. 31, 1918, pp. 166-167, 3 figs. Plans made by City Plan Commission of Cleveland for increasing corner radii and angle of vision.

EARTH ROADS. Method of Handling Materials for Concrete Roads. Eng. & Cement World, vol. 13, no. 7, Oct. 1, 1918, p. 31, 2 figs. Advantages of eliminating stock piles along route.

The Location, Construction and Maintenance of Earth Roads, H. R. MacKenzie. Jl. Eng. Inst. of Can., vol. 1, no. 5, Sept. 1918, pp. 181-186. Emphasizes engineering supervision of construction and constant attention to maintenance as principal factors necessary to make of an earth road a satisfactory highway.

FURNACE-SLAG SUBCRUST. Roads During and After the War, E. Purnell Hooley. Surveyor, vol. 54, no. 1385, Aug. 2, 1918, pp. 59-60. Use of furnace slag as a subcrust in macadam and telford roads. Paper before Intsn. Mun. and County Engrs.

HIGHWAYS. State-Aid Highway Work in Illinois, C. M. Hathaway. Am. City, vol. 19, no. 3, Sept. 1918, pp. 176-182, 3 figs. Widths, drainage, alignment and design of state-aid roads; discussion of construction materials — concrete, brick, bituminous, macadam and oiled earth; state-aid bridge work; grade-crossing problems. (Concluded.)

The Planning of a System of Rural Highway Under Conditions Existing in Province of Saskatchewan, W. M. Stewart. Jl. Eng. Inst. of Can., vol. 1, no. 5, Sept. 1918, pp. 198-192 and (discussion) 192-193. Classification of roads and determination of satisfactory type of surface to be used on a certain road from an estimate of volume and class of traffic to be provided for. Also pubblished in Can. Engr., vol. 35, no. 10, Sept. 5, 1918, pp. 217-218.

Typical Specifications for Non-Bituminous Road Materials. Prevost Hubbard and Frank H. Jackson. U. S. Department of Agriculture, Bul no. 704, professional paper, Nov. 30, 1918, 38 pp. Specifications for 19 common materials used in the construction and maintenance of various types of highways; descriptions of methods of testing to which reference is made in specifications.

WOOD BLOCK PAVEMENTS. Proper Method of Application of Bituminous Filler for Creosoted Wood Block Pavements and Floors, Lambert T. Ericson. Eng. & Contracting, vol. 50, no. 14, Oct. 2, 1918, pp 320-321, 2 figs. To prevent an excess of tar on pavement in hot weather, joints should be filled with tar or other bitumen at a high temperature so that joints will be well penetrated, details of proper application given.

SAFETY ENGINEERING

ACETYLENE, DISSOLVED, CYLINDERS FOR. Report of the Departmental Committee on Cylinders for Dissolved Acetylene (VI). Acetylene & Welding Jl., vol. 15, no. 179, Aug. 1918, pp. 146-150, 2 figs. Report on two samples of charcoal and on alternating pressure tests made on two dissolved acetylene cylinders. (Concluded.)

BLOW-OFF TANKS. Explosion of a Blow-off Tank. Travellers Standard, vol. 6, no. 9, Sept. 1918. pp. 177-181, 3 figs. Suggestions on construction and installation of blow-off tanks derived from an account of a recent explosion at a Cleveland manufacturing plant.

CONSTRUCTION WORK. Benefit of Accident Prevention in Contracting, F. S. Robinson. Eng. & Contracting, vol. 50, no. 13, Sept. 25, 1918, pp. 311-312. Abstract of paper before Construction Section of National Safety Council, Sept. 1918.

Safety Engineering and Accident Prevention in Construction Work, Leo D. Woedtke. Eng. & Contracting ,vol. 50, no. 13, Sept. 25, 1918, pp. 299-303. Accident prevention methods of Fred T. Ley & Co., Inc. Abstract from address before Construction Section Meeting of National Safety Council, Sept. 1918.

DUST INHALATION. Effects of Mine-Dust Inhalation, J. S. Haldane. Eng. & Min. Jl., vol. 106, no. 11, Sept. 14, 1918, pp. 475-477. Effects of various kinds of dusts when breathed by mine or mill workers. From paper submitted to Chem. Metallurgical & Min. Soc. of South Africa, and Instn. of Min. Engrs., London. Published also in Trans. Instn. Min. Engrs., vol. 55, part 4, Aug.-Sept. 1918, pp. 264-273 and (discussion) pp. 273-293.

DUST EXPLOSIONS. Considerations Respecting Causes of Dust Explosions (Einiges über Staubexplosionem), G. Bauer. Zeitschrift für agewandte Chemie, year 30, no. 79, Oct. 2, 1917, pp. 239-240, 4 figs.

EXPLOSIVES. Safety in the Use of Explosives, Arthur La Motte. Coal Age, vol. 14, no. 11, Sept. 12, 1918, pp. 490-496. Paper before Nat. Safety Council.

FIRE HAZARDS. The Factory Fire Brigade (I), Paul Mason. Am. Indus., vol. 19, no. 2, Sept. 1918, pp. 14-16. Organization, equipment and discipline.

FIRST AID. Elementary First Aid for the Miner, W. A. Lynott and D. Harrington. Sci. & Art of Min., vol. 29, no. 2, Aug. 24, 1918, pp. 22-23. What to do at once when a fellow miner is hurt; general directions for caring for bleeding; miscellaneous precautions; dressing for broken bones; electric shock. From Miner's Circular 23, U. S. Bureau of Mines.

FLYING OBJECTS. Injury from Flying Objects, Chesla C. Sherlock. Am. Mach., vol. 49, no. 14, Oct. 3, 1918, pp. 625-627. Legal aspects of injuries received from flying objects discussed.

HEADLIGHTS, AUTOMOBILE. Automobile Headlights and Glare Reducing Devices, L. C. Porter. Gen. Elec. Rev., vol. 21, no. 9, Sept. 1918, pp. 627-632, 13 figs. General discussion showing set of curves indicating candlepower necessary to " pick up " a man at various distances.

Dazzling Head Lamps. Autocar, vol. 41, no. 1192, Aug. 24, 1918, p. 188. Tests and standard specifications adopted in New York State.

LIGHTNING ARRESTERS. The Oxide Film Lightning Arrester, Crosby Field. Gen. Elec. Rev., vol. 21, no. 9, Sept. 1918, pp. 597-601, 6 figs. Principle, construction and operation of instrument which consists essentially of an insulating film placed between a conductor and lead peroxide.

MACHINERY MOVEMENTS. Abnormal Movement of Machinery, Chesla C. Sherlock. Am. Mach., vol. 49, no. 13, Sept. 26, 1918, pp. 578-580. Discussion of accidents due to a sudden and abnormal movement of machinery, taking operator by surprise, and legal aspects.

MINE ACCIDENTS. Who Gets Hurt and Why. Coal Age, vol. 14, no. 11, Sept. 12, 1918, pp. 480-482, 7 figs. Details relating to total distribution of mine accidents, from records of Ellsworth Collieries.

QUARRYING. Safe Practices in the Quarry and Mill, William H. Baker. Eng. & Cement World, vol. 13, no. 4, Aug. 1918, pp. 53-54. Precautions taken at Hannibal, Mo., mills of Atlas Portland Cement Co. Abstract of paper before Nat. Safety Council.

RAILROAD ADMINISTRATION, SAFETY WORK. Safety Program of Railroad Administration, Hiram W. Belnap. Ry. Rev., vol. 63, no. 12, Sept. 21, 1918, pp. 426-428. What it expects of different organizations in promotion of safety work. Abstract from paper before Nat. Safety Council, St. Louis.

SCAFFOLDS. Safe Construction of Scaffolds and Falsework, T. F. Foltz. Eng. & Contracting, vol. 50, no. 12, Sept. 18, 1918, pp. 285-288. Abstract of paper before National Safety Council

SMALL SHOPS. How Accident Prevention Work May Be Carried On in Small Companies, Wills Maclachlan. Am. Gas. Eng. Jl., vol. 109, no. 14, Oct. 5, 1918, pp. 319-322. Suggestions in regard to equipment and organization. Paper before National Safety Congress.

WINDING ENGINES. Safety in Winding Operations, J. A. Vaughan. South African Mining Jl., vol. 27, part 2, no. 1399, July 20, 1918, pp. 269-260. Remarks on safe handling of winding engine based on author's experience and compiled statistics of winding accidents in the Witwatersrand. Paper before the S. A. A. A. S.

SANITARY ENGINEERING

PLUMBING. [illegible] Sanitary Engineering [illegible] 1918, pp. [illegible] 7 figs. [illegible]

SEWAGE DISPOSAL. Sewage Disposal, Edward Walter[illegible]. Surveyor, vol. 54, no. 1387, [illegible] 1918, pp. [illegible] [illegible] Published also in Can. Engr., vol. [illegible] no. 10, Sept. 5, 1918, pp. 221-22[illegible].

WATER SUPPLY. Improvements [illegible] Artesian Water Supply at Savannah, [illegible] E. R. Conant. Am. City, vol. 19, no. 3, Sept. 1918, pp. 182-192, 1 fig. From paper presented at convention of Am. Water Works Assn.

STANDARDS AND STANDARDIZATION

GAS METER THREADS. Standardization of Gas Meter Threads and Connections in Germany (Die Vereinheitlichung der Gasmesser-Verschraubungen und Verbindungen), D. [illegible]. Journal für Gasbeleuchtung, vol. 61, no. 16, Apr. 20, 1918, pp. 181-183, 2 figs.

PYROMETERS. Pyrometer Standardization, Ezer Griffiths and F. H. Schofield. Trans. Faraday Soc., vol. 13, part 3, June 918, pp. 222-237, 6 figs. Indicates temperature-scale basis of practical types and errors to which pyrometric observations are liable.

SCREW THREAD. The Relation of Screw-Thread Angles to Other Functions, H. J. Bingham Powell. Am. Mach., vol. 49, no. 13, Sept. 26, 1918, pp. 571-573, 1 fig. Author sets forth his reasons for advocating adoption as an international standard the Whitworth thread.

TUBES, SEAMLESS. International Aircraft Standards. Flight, vol. 10, no. 33, Aug. 15, 1918, p. 919. Specifications for alloy-steel seamless tubes of 200,000 lb. per sq. in. tensile strength. (Continued.)

STEAM ENGINEERING

BOILER GAGE GLASS. The Boiler Gage Glass, Wm. L. De Baufre. Jl. Am. Soc. Naval Engrs., vol. 30, no. 3, Aug. 1918, pp. 547-556, 2 figs. Explains how to determine actual weight of water contained in boiler, and gives corrections to be applied in tests where the gage-glass reading, the steam pressure and the rate of steaming at the end of a run are different from those obtaining at the beginning.

BOILERS. Examination of Steam Boilers at Collieries, Edward Ingham. Colliery Guardian, vol. 116, no. 3007, Aug. 16, 1918, pp. 336-337, 9 figs. Typical defects found in inspection of boilers explained.

Steam-Boiler Regulation and Control, Albert A. Straub. Power, vol. 48, no. 13, Sept. 24, 1918, pp. 442-446, 6 figs. Brings out point that proper-handling of damper for controlling draft for steam-boiler furnaces is of importance, and presents charts showing variation of temperature of escaping gases and of steam pressure.

PRESSURE LOSSES. Pressure Losses in Steam Plants, R. S. Hawley. Power Plant Eng., vol. 22, no. 18, Sept. 15, 1918, pp. 739-741, 2 figs. Causes; distinction between losses due to throttling and radiation.

SCALE, BOILER-TUBE. Boiler-Tube Scale; Its Removal with Kerosene as Practised at the Fuel-Oil Testing Plant, Albert M. Penn. Jl. Am. Soc. Naval Engrs., vol. 30, no. 3, Aug. 1918, pp. 512-517, 2 figs. 15 gal. of kerosene were poured into each lower drum with tin funnel, 100-lb. steam allowed to flow in and condense until water glass was three-quarters full. Photographs showing results and precautions advised.

SOOT REMOVAL. Soot Removal from Fire-Tube Boilers. Power, vol. 48, no. 9, Aug. 27, 1918 pp. 305-308, 13 figs. Rear-end and front-end blowers for return tubular boilers, rocking elements for internally fired boilers and gear-turned blowers for vertical boilers.

STEAM, HIGH-PRESSURE. Advantages of High Pressure and Superheat as Affecting Steam Plant Efficiency, Eskil Berg. Elec. Rev., vol. 73, no. 12, Sept. 21, 1918, pp. 444-447, 3 figs. Possibilities of higher steam pressures and temperatures for reducing mechanical and thermal losses in turbines.

The Uses of High-Pressure and High-Temperature Steam in Large Power Stations, J. H. Shaw. Contract Rec., vol. 32, no. 35, Aug. 28, 1918, pp. 703-705. Comparison of costs illustrated by schedule showing coal, steam and heat consumption for a 20,000-kw. machine running at 200 lb. and 350 lb. gage pressure at varying superheats and also at 500 lb. pressure absolute and 268 deg. fahr. superheat. Paper before Instn. Civ. Engrs. Also published in Elec. News, vol. 27, no. 17, Sept. 1, 1918, pp. 29-31, and in Elecn., vol. 81, no. 2100, Aug. 16, 1918, pp. 330-332, 5 figs.

SUPERHEATERS. General Construction and Maintenance of Superheater Units. Ry. & Locomotive Eng., vol. 31, no. 10, Oct. 1918, pp. 315-316, 4 figs. Device especially designed to prevent leakage in the joints and rapid deterioration of the ends of superheater pipes.

The Value of Superheated Steam at the Colliery and at Iron Works. Iron & Coal Trades Rev., vol. 97, no. 2635, Aug. 30, 1918, pp. 238-239, 2 figs. Description of Sugden superheater, with Stirling boiler and independently fired.

TURBINES. A 35,000-kw. Turbine is Wrecked in Northwest Station, Chicago. Power, vol. 48, no. 10, Sept. 3, 1918, pp. 345-348, 4 figs. Detailed description of accident to 35,000-kw. turbine at Northwest Station, Chicago. Failure of nineteenth wheel probable cause of wreck.

Additional Power at Small Cost by Exhaust Steam Turbine. Can. Machy., vol. 20, no. 11, Sept. 12, 1918, pp. 317-318, 3 figs. Saving of fuel and boiler capacity obtained in paper mill by connecting steam turbines to line shaft through reduction gear.

The Forty-five Thousand Kilowatt Compound Turbine at Providence, R.I., J. P. Rigsby. Power, vol. 48, no. 9, Aug. 27, 1918, pp. 292-298, 9 figs. Illustrated description of 45,000-kw. cross-compound reaction Westinghouse turbine at Providence, R.I.

VALVES, SAFETY. Graphic Methods of Determining Size of Safety Valve, H. F. Gauss. Power, vol. 48, no. 12, Sept. 17, 1918, pp. 414-417, 4 figs. Reasons for increasing maximum allowable lifts above those permitted in the A.S.M.E. Code. Napier's formula for the flow of steam through an orifice used as a basis for constructing capacity curves. General solution by means of logarithmic charts.

Safety and Relief Valves, M. W. Rink. Jl. Am. Soc. Naval Engrs., vol. 30, no. 3, Aug. 1918, pp. 504-511, 7 figs. Construction and use of shifting and cylinder relief valves for a mixture of steam and water. From Marine Eng.

STEEL AND IRON

BY-PRODUCTS. By-Product Recovery in Iron and Steel Works. Engineering, vol. 106, no. 2747, pp. 206-207. Utilization of gas and other by-products of iron and steel works. From paper by. A. Gouvy before Congrès du Génie Civil, Paris, March 1918.

BLAST FURNACES. Fuel Economy in Blast Furnaces, T. C. Hutchinson. Iron Age, vol. 102, no. 12, Sept. 19, 1918, pp. 689-691, 3 figs. Cleaning the ore and size of bell factors in larger output and lower coke consumption in British practice; long life of furnace walls. From paper before Iron & Steel Inst., London, May 1918.

CASTING. Sound Steel by Lateral Compression, Benjamin Talbot. Iron Age, vol. 102, no. 14, Oct. 3, 1918, pp. 836-838, 2 figs. British results from applying this principle to tap portion of slag; cheap refractory top of slag. From paper before Iron & Steel Inst., London, May 1918.

CORROSION. Corrosion of Iron and Steel, and its Prevention (VII), Abe Winters. Can. Machy., vol. 20, no. 9, Aug. 29, 1918, pp. 257-258. Considerations on sherardizing process (covering heated iron with zinc dust) with reference to temperature and time, and its commercial application.

ELECTRIC STEEL. Electric Steel Making, Arthur V. Farr. Machy., vol. 25, no. 1, Sept. 1918, pp. 40-42, 9 figs. Importance and growth of electric-steel industry; cold-melt process and structure of electric steel.

The Electric Furnace in the Steel Casting Industry, W. E. Moore. Elec. Jl., vol. 15, no. 9, Sept. 1918, pp. 331-332. Remarks on advantages and disadvantages of various processes of manufacturing steel — crucible melting, open-hearth, side-blow converter, and the electric furnace.

The New Electric Steel Plant at Toronto (La nouvelle aciérie électrique de Toronto). Génie Civil, vol. 72, no. 26, June 29, 1918, pp. 479-481, 3 figs. Plans, views and description.

FERRO-ALLOYS. The Manufacture of Ferro-Alloys in the Electric Furnace, R. M. Keeney. Min. Jl., vol. 122, no. 4334, Sept. 14, 1918, pp. 538-539. Ferrouranium. Paper before Am. Inst. Min. Engrs. (Continuation of serial.)

IRON, MOLECULAR INSTABILITY. Molecular Instability Due to Magneto-striction (Instabilité moléculaire par la magnétostriction), D. Hurmuzescu. Revue Générale de l'Electricité, vol. 4, no. 7, Aug. 17, 1918, pp. 211-214, 1 fig. Results of experimental study which led author to assert that, unlike steel, iron under certain conditions possesses molecular instability.

IRON, TITANIUM ORES. On the Microstructure of Certain Titanium Iron Ores, Chas. H. Warren. Economic Geology, vol. 13, no. 6, Sept. 1918, pp. 419-446, 12 figs. Experimental study of titanium-iron-oxide minerals, including a number of ilmenites from different parts carried out on large Leitz metallographic microscope, using a small 4-ampere arc as source of light.

ORE RESOURCES. Notes on Certain Iron-Ore Resources of the World, C. E. Harder, W. Lindgren, C. M. Weld, A. C. Spencer, H. F. Bain, and Sidney Paige. Bul. Am. Inst. Min. Engrs., no. 141, Sept. 1918, pp. 1471-1496. Brazil, Scandinavia, Cuba, Southern Europe, China, and Alsace-Lorraine.

Application of Optical Pyrometry in Steel Works Practice, J. N. Greenwood. Trans. Faraday Soc., vol. 13, part 3, June 1918, pp. 295-308, 4 figs. Comparison of various conditions of use of an optical pyrometer in taking temperatures of liquid steel in the open with calibration conditions; errors due to emissivity; polarization of emitted light, and lack of monochromatism; technical defects of the Cambridge type; suggestion to obtain control of steel-making process pyrometrically.

PYROMETRY. Notes on Pyrometry from the Standpoint of Ferrous Metallurgy. W. H. Hatfield. Trans. Faraday Soc., vol. 13, part 3, June 1918, pp. 289-294. Account of methods to control temperature used in large armament works.

Temperature Determinations of Liquid Steel, A. McCance, Trans. Faraday Soc., vol. 13, part 3, June 1918, pp. 309-310. Work done at the Parkhead Steel Works to develop a system of controlling the temperature in an open-hearth furnace by an optical pyrometer.

The Determination of the Temperature of Liquid Steel Under Industrial Conditions, Cosmo Johns. Trans. Faraday Soc., vol. 13, part 3, June 1918, pp. 280-288. Account of author's experience; suggestion, to adopt as standard an optical pyrometer using monochromatic light $\lambda = 0.65\ \mu$.

SEMI- STEEL. Steel Mixture Iron — The Use of Scrap Steel in Pig Iron Mixtures. Contract Rec., vol. 32, no. 37, Sept. 11, 1918, pp. 731-732. Factors involved in absorption of carbon from coke by steel during cupola melting and experiment illustrating this absorption; results obtained from melting steel borings and crop ends from smithy in a cupola together with 10 per cent ferrosilicon. From the Engineer, London.

STEEL, HARDNESS AND TENSILE STRENGTH. Tensile Strength and Hardness of Steel, H. M. Brayton. Iron Age, vol. 102, no. 11, Sept. 12, 1918, pp. 627-629, 3 figs. Their relation shown by means of graphical charts which give either variable in terms of the other.

STEEL MILLS. Fuel Economy in a Modern Steel Works, Benjamin Talbot. Colliery Guardian, vol. 116, no. 3010, Sept. 6, 1918, pp. 493-494. Examination of most economical fuel consumption possible to obtain in practice in a modern steel works. Appendix II to Carbonization Committee's Report, Board of Trade. Also published in Iron & Coal Trades Rev., vol. 97, no. 2634, Aug. 23, 1918, pp. 210.

Mechanical and Electrical Equipment of a Southern Steel Mill. Southern Engr., vol. 30, no. 2, Oct. 1918, pp. 36-43, 12 figs. Waste-heat boiler installation, mixed-pressure turbines, motor drive for billet mills, roughing mills and other machinery, motor control.

Tubes, Seamless. Tubes and Tubular Structures, W. W. Hackett and A. G. Hackett. Aviation, vol. 5, no. 4, Sept. 15, 1918, pp. [illegible]. Review of method of manufacturing seamless steel tubing, of difficulties to be overcome and form of manipulation which it is possible to put upon [illegible] account of tests carried out on specimen tubes under [illegible] and joined together in different ways. Paper before Aeronautical Soc. of Great Britain.

Wire-Rod Mills. Designing Passes for Wire Rod Mill Rod [illegible], W. S. [illegible]. Am. Mach., vol. 49, no. 14, Oct. [illegible], 1918, pp. [illegible], 5 figs. Design of rod passes and difficulties encountered in manufacture of rods.

TESTING AND MEASUREMENTS

Calorimeters. Some Points Regarding Calorimeter Efficiency, Walter P. White. Jl. Franklin Inst., vol. 186, no. 3, Sept. 1918, pp. 279-287. Sources of calorimetric error and considerations on different types of these instruments with reference to moderately high precision demanded in commercial work.

Electrical Apparatus. The Engineering Evolution of Electrical Apparatus (XXXII), Chas. R. Riker. Elec. Jl., vol. 15, no. 9, Sept. 1918, pp. 357-362, 14 figs. Synchroscopes; power-factor meters; frequency meters; ground detectors; compensated instruments.

Engine Testing. The New Duesenberg Aero Engine Test House. Aerial Age, vol. 8, no. 2, Sept. 23, 1918, pp. 66-67, 4 figs. Processes followed at laboratories of Duesenberg Motors Corporation in analysis of construction materials.

Hardness Testing. Brinell Hardness Test, J. G. Ayers, Jr. Iron Age, vol. 102, no. 10, Sept. 5, 1918, pp. 581-582, 3 figs. New method insuring quick commercial results of sufficient accuracy. Paper before Am. Soc. for Testing Materials.

High-Temperature Measurements. The Automatic Control and Measurement of High Temperatures, Richard P. Brown. Trans. Faraday Soc., vol. 13, part 3, June 1918, pp. 246-252. Operation of Brown heat meter.

Meters, Electric. Meter Installation for Determining Energy Accuretely in Three-Phase Systems (Sur un montage des compteurs enregistrant l'énergie des postes triphasés permettant la détermination de l'énergie magnétisante et donnant une plus grande sécurité de bon fonctionnement), P. Bourguignon. Revue Générale de l'Electricité, vol. 4, no. 7, Aug. 17, 1918, pp. 214-217, 2 figs. Method to determine ccs ϕ by means of two monophase meters.

Pyrometry. Base-Metal Thermoelectric Pyrometers, Chas. R. Darling. Trans. Faraday Soc., vol. 13, part 3, June 1918, pp. 344-347, 2 figs. Couples employed: iron-constanan, two iron-nickel alloys of different composition, and two different nikel-chrome alloys known as Hoskins' alloys.

Bibliography on Pyrometers, Robert Hadfield. Trans. Faraday Soc., vol. 13, part 3, June 1918, pp. 362-372. Pamphlets, papers and cuttings; British and American patents; books.

Note on the Wiborgh Pyrometer, John G. A. Rhodin. Trans. Faraday Soc., vol. 13, part 3, June 1918, pp. 260-261, 4 figs. Description of instrument. From Jernkontorest Annaler.

Notes on the Remediable Causes of Unreliability Encountered in Thermo-electric Pyrometry, Especially in Systems of the Base-Metal Type, G. E. M. Stone. Trans. Faraday Soc., vol. 13, part 3, June 1918, pp. 348-355, 1 fig., and (discussion) pp. 355-359. Efforts of various manufacturers to construct an efficient pyrometer by using base metal thermocouples in conjunction with pivot millivoltmeters.

Optical Pyrometry in Non-Ferrous Metallurgy, F. G. Donnan. Trans. Faraday Soc., vol. 13, part 3, June 1918, pp. 276-279, 2 figs. Corrections necessary in reading of optical pyrometers when measuring temperatures of molten metal, in the cases of gold and copper.

Pyrometers, Their Construction and Repair, J. V. Lucas. Am. Mach., vol. 49, no. 11, Sept. 12, 1918, pp. 471-477. 17 figs. Description of construction and of minor repairs which can be made without returning instrument to maker.

The Measurement of High Temperatures by Means of Pottery Materials, Henry Watkin. Trans. Faraday Soc., vol. 13, part 3, June 1918, pp. 330-340, 10 figs., and (discussion) pp. 341-343, 1 fig. Types of pyrometer based on principle of contraction of pottery materials under influence of heat.

The Relation of Optical and Radiation Pyrometry to Modern Physics, Paul D. Foote. Trans. Faraday Soc., vol. 13, part 3, June 1918, pp. 238-245, 1 fig. Study of constants in Planck's spectral distribution law and Stefan-Boltzman law of radiation in their relation with constants of other important radiation laws.

Thermocouples. The Advantage of Burying the Cold Junction of a Thermocouple as a Means of Maintaining it at a Constant Temperature, Robert S. Whipple. Trans. Faraday Soc., vol. 13, part 3, June 1918, pp. 253-259, 5 figs. Method used in connection with experimental work at Cambridge Scientific Instrument Co.

Track Scales. War Time Standardization of Railroad Track Scales, C. A. Briggs. Scale Jl., vol. 4, no. 12, Sept. 10, 1918, pp. 9-10. Recountal of recent efforts of Bureau of Standards. Paper before Scale Mfrs.' Assn.

Working Stresses for Railroad Track Scale Design. Scale Jl. vol. 4, no. 12, Sept. 10, 1918, p. 7, 1 fig. Nat. Bureau of Standards data including allowances for import carried by moving loads.

Ultra-Violet Rays. Ultra-Violet Light, Its Application in Chemical Arts (XIV), Carleton Ellis and A. A. Wells. Chem. Engr., vol. 26, no. 7, June 1918, pp. 263-272. Testing smokeless powder and many organic compounds by effect produced on them with exposure to ultra-violet radiations.

TRANSPORTATION

Delivery Zones. How Delivery Zones Will Reduce Freight Traffic, E. Amberg. Am. City, vol. 19, no. 3, Sept. 1918, pp. 179-180, 2 figs. Feature of plan being worked out by U. S. Railroad Administration to reduce congestion of freight traffic in New York.

Freight Handling. [illegible] C. H. [illegible]. Motor Traction, vol. 27, no. 705, Sept. 4, 1918, pp. 165-168, 2 figs. Suggests forms of standard chassis which can be fitted with two or three standard type bodies, and apparatus for loading and unloading certain classes of goods.

WOOD

Decomposition. Durability of Untreated Piling Above Mean Low Tide, C. H. Teasdale and M. E. Thorne. Ry. Gaz., vol. 29, no. 10, Sept. 6, 1918, p. 257. Report on protection afforded to timber by saturation above water level. Prepared by questionnaire method at U. S. Forest Products Laboratory.

Fungi, the Cause of Decomposition of Timber, P. H. Dudley. Wood-Preserving, vol. 5, no. 3, July-Sept. 1918, pp. 26-35, 10 figs. Brief details of the life history of trees and fungi.

Pipes. The Possibilities of [illegible] Wood Stave Pipe for [illegible] Irrigation or Water Supply [illegible] P. M. [illegible]. Wood-Preserving, vol. 5, no. 3, July-Sept. 1918, pp. 37-38, 1 fig. Experimental work in perforating outer surface of staves with small holes systematically spaced.

Poles. Economics of Pole Timber, Ernest F. Hartman. Elec. World, vol. 72, no. 13, Sept. 28, 1918, pp. 590-591, 1 fig. Preservation of poles and arresting of decay in advanced stages.

Maintenance Cost of Poles, W. F. Goltra. Wood-Preserving, vol. 5, no. 3, July-Sept. 1918, pp. 35-36. Table showing discounted value of annual return of one, obtainable for 1 to 55 years.

Uses. The Uses of Wood. The Place of the Wooden Roof in Civilization (IV). Am. Forestry, vol. 24, nos. 296 and 297, Aug. 1918 and Sept. 1918, pp. 473-482, 15 figs., and pp. 533-541, 21 figs. Various phases of subject, from beginnings in the forests through processes of logging, lumbering, transportation and milling, considering details in field of utilization and manufacture of wood.

WOODWORKING MACHINERY

Propeller-Shaping Machine. Aero-Propeller Shaping Machine. Can Machy., vol. 20, no. 8, Aug. 22, 1918, pp. 227-228, 2 figs. Ransome-Kerr machine which works by copying the profile of a model blade.

VARIA

Abaci. The Construction of Abaci, A. B. Eason. Elecn., vol. 81, no. 2100, Aug. 16, 1918, pp. 339-341, 6 figs. How to draw up abaci for use in solving various common engineering problems without using tables and slide rules.

Diamonds. The Diamond, Charles Parsons. Sci. Am. Supp., vol. 86, no. 2225, Aug. 24, 1918, pp. 124-126, 12 figs. Theories and experiments in forming artificial gems. From lecture before Inst. of Metals, published in The Engineer (London).

Education. Broader Foundation Demanded for Engineering Education, Frederick Bass. Eng. News-Rec., vol. 81, no. 13, Sept. 26, 1918, pp. 582-583. Higher aims also needed; students' longings not met; vision of great practitioners should guide educators.

The Engineer and the War, M. E. Cooley. Jl. Engrs. Club of St. Louis, vol. 3, no. 4, July-Aug. 1918, pp. 211-213. Tabular presentation of output of all engineering schools of United States since 1895. From Michigan Technic.

Electrical Industry. Business Conditions in the Electrical Industry. Elec. Rev., vol. 73, no. 10, Sept. 7, 1918, pp. 363-384. A summary of views obtained from leading manufacturers and jobbers regarding present conditions in industry and outlook for the future.

Engineers, Legal Status. Legislation Concerning the Status of Engineers, F. H. Peters. Jl. Eng. Inst. of Can., vol. 1, no. 5, Sept. 1918, pp. 217-220 and (discussion) 220-221. Account of work done by Inst. toward establishing some legal standard and make it possible to control-organization.

Foreign Markets. Testing the Buying Power of a Foreign Market, L. W. Schmidt. Am. Mach., vol. 49, no. 13, Sept. 1918, pp. 581-584. Suggestions as to ways of estimating probable markets to see whether it will pay to send representatives; sources of information and how it can be judged and collated.

Latitude Determinations. Common Methods of Determining Latitude and Azimuth Useful to Engineers and Surveyors. Harry J. Wolf. Quarterly of the Colo. School of Mines, vol. 13, no. 3, July 1918, pp. 3-13. Latitude by observing altitude of sun at noon or that of polaris at culmination; azimuth by altitude of sun, or equal a. m. and p. m. altitudes of sun, by polaris at elongation culmination or any hour-angle.

Microtelescope. Optical Devices Aid Science and Industry. Can. Machy., vol. 20, no. 9, Sept. 5, 1918, p. 301, 5 figs. Recently produced microtelescope consisting of a microscope of ordinary construction carrying a short-focus telescope objective and tube below the stage.

Pole Stubs, Driving. Driving Pole Stubs with Motor Truck. Telephony, vol. 75, no. 9, Aug. 31, 1918, p. 27, 3 figs. How reinforcing piles were driven to a depth of 14 ft. alongside poles of toll line which passed through a section of silty ground.

Salesmanship. Engineering Salesmanship, Charles W. Hunt. Machy., vol. 25, no. 1, Sept. 1918, pp. 7-8. First principle of salesmanship; qualifications of a good engineering salesman; importance of personality; resourcefulness; investigation of complaints; inside support; post-war conditions. From paper before Manchester Assn. of Engrs.

EMPLOYMENT BUREAU

A Clearing House of Engineering Positions in Canada.

This department is one of the features by which it is hoped to be of greater service to the engineer and particularly the younger men. Firms and individuals requiring engineering assistance will have their inquiries listed in this department. Those out of employment or desirous of a change are invited to make use of it, without charge and in confidence.

The Salary Situation

Inasmuch as this page is designed to assist the members in connection with positions and also to endeavor to raise the standard, a letter received recently on this subject from one who no doubt feels very deeply in the matter, is reproduced below. The main point raised in this letter namely, that the salaries of engineers are ridiculously low at the present time, is one with which all will agree. While it would be impossible to adopt an absolute schedule it seems reasonable that some understanding should be reached regarding the remuneration that men doing certain work and of a certain standard, should receive. The main difficulty in the past has been that we as engineers have not been individually educated to a proper appreciation of our own work, and consequently the outside world has taken advantage thereof.

Constructive suggestions in connection with this situation might be sent in by those who have definite ideas in the matter.
Editor, *Journal.*

I would very much like to know what is being done lately regarding salaries of engineers. Though only at present a junior, I have been stationed here in charge of some 388 miles of operated road, at a salary of one hundred and fifty dollars per month. This with expenses on line only when away from here, and my family is in Toronto. I have all field work, drafting and office correspondence, besides all the appropriations for next year's work, including all plans attached thereto and all bills of material, leases etc., amounting in all to considerably over a quarter of a million dollars.

I fully expected a substantial advance along the lines the *Institute* were working for, and was willing to do anything within reason towards there ends. It seems to me that we are too long suffering as you must admit that such a case as mine is entirely out of all reason. The McAdoo award was based on the scale of December, 1915, which would mean the same as the present day for me. Then I would be getting $125. and expenses away from headquarters, which is equivalent to the present $150. and pay my own expenses while at headquarters. As I am here the greatest part of the time this is more than I can bear. (Bed and board is $45.00 per month here.)

A peculiar feature is the fact that Toronto is really the headquarters, as an engineer is sent from there every year for the summer months only. The engineer, when away from here has, out of his salary, to put up his own expenses and that of his two men, getting a refund once a month, besides maintaining a family at another place. Now I have proved that the salary is entirely inadequate for even expenses, let alone dress, etc. Of course one may quit, but I do not happen to be made of that stuff. I believe in our *Institute* and think that a schedule should be arranged to suit the profession. Trainmen draw nearly $150. half-monthly here, while I draw only $75. This is more than unfair, it is grossly unjust, and it is time that readjustments reached us. One at the Pacific Coast it was a case of other than Canadians being employed, while the Canadians walked, but with one exception such was not my case. On that occasion I interviewed one of the highest authorities in Ontario in the person of The Hon. N. W. Rowell. Now it is a question of salary, and good case too as I believe you will admit. When the readjustment comes I believe I for one can live happy ever after.

It seems to me that if the Institute were to grade the standings of the profession according to position and experience, and announced a definite scale, that every last one of us would stand up by that schedule and be governed accordingly. And that it would also be incumbent on us to see that we held our places pending the readjustment, and that none out of the *Institute* should be allowed to hold positions that are bonafide, in the whole of Canada. I believe that we should be more aggressive in this matter, otherwise to undertake the education of public opinion, requires considerable time, (and suffering).

Trusting to hear from you of any late means of readjustment have been taken.

Yours for the Victory Loan,

RESIDENT ENGINEER.

October 14, 1918.

* * *

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An Opportunity

An opportunity is again being given to members of the Institute to contribute to a Tobacco Fund in order to enable us to send tobacco and cigarettes as a Christmas remembrance to our gallant fellows engaged in active service.

At the meeting of Council held Tuesday, September 24th, the proposal to establish a Tobacco Fund similar to that of last year was given hearty endorsation and the Secretary was instructed to proceed with arrangements.

Branch members are requested to forward their contributions to their own Branch Secretary.

Kindly tear off the lower portion of this page, attach your contribution and send it as soon as convenient.

TEAR OFF HERE.

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GENERAL SPECIFICATION FOR STEEL RAILWAY BRIDGES

(Final draft as approved by Meeting of Committee held on October 17, 1918).

INTRODUCTORY

1. This specification applies to steel railway bridges; but does not cover the design of suspension bridges, nor of turntables for locomotive engines.

2. When highway traffic is to be accommodated, the various parts of the bridge pertaining thereto, shall be designed in accordance with *The Institute's* General Specification for Steel Highway Bridges.

3. The purchaser's engineer is expected to furnish full information with respect to the type of floor, the class of live-load and other data called for in appendix V.

GENERAL FEATURES

Clearances.

4. Single-track through bridges on tangents shall have a clear opening not less than indicated by the upper diagram, appendix I; on curves, additional lateral clearances shall be provided, as shewn on the lower diagrams:—

in which W=lateral clearance from centre-line of track required for bridges on tangents;

M=middle ordinate of curve for chord equal to length of span;

X=additional lateral clearance required for the overhang of an 85-foot car with trucks 60 feet centre to centre, to be taken as one inch for each degree of curvature;

Y=additional lateral clearance, in inches and on inside of curve only, required on account of superelevation of outer rail, and computed by the formula:—

$$Y=\frac{sh,}{5}$$

where s=superelevation, in inches; and h=height above base of rail, in feet.

5. For through bridges with two or more tracks, the latter shall be spaced as required by the purchaser, but not less than 12 feet centre to centre; and the lateral clearances between the centre-line of track and the adjacent truss shall be as specified above for single-track bridges.

Superelevation for Outer Rail.

6. For bridges on curves, provision shall be made for the superelevation of the outer rail, which superelevation shall be as specified by the purchaser's engineer.

Spacing of Trusses.

7. The distance, centre to centre of trusses or main girders, shall not be less than one-twentieth (1/20) of the effective span, nor less than is necessary to prevent overturning under the specified lateral forces.

Skew Ends.

8. At abutments, the ends of track-stringers for skew bridges shall be square to the track, unless a continuous ballasted floor is used.

FLOOR

Type of Floor.

9. The type of floor shall be as specified by the purchaser's engineer.

Timber Floors.

10. Cross-ties shall be proportioned to carry the maximum wheel-load with 100% impact, distributed uniformly over 3 feet of track; they shall be spaced not over 4 inches apart in the clear; they shall be secured to the stringers, and adequate provision shall be made to prevent bunching. The length of cross-ties, together with the arrangement and size of guard-timbers and guard-rails, shall be as required by the purchaser's engineer.

Ballasted Floor

11. Transverse girders and trough-sections for supporting ballasted floors shall be proportioned for the maximum wheel-load, with 100% impact, distributed uniformly over 3 feet, or a length of track equal to twice the depth of the floor (measured from the base-of-rail to the top of the supporting steelwork). Reinforced-concrete slabs shall be proportioned for the same wheel-load and impact as above, distributed over 3 feet, or a length equal to twice the depth of the floor (measured from the base-of-rail to the upper side of the slab), and in accordance with *The Institute's* General Specification for Reinforced-Concrete. In all cases, suitable provision shall be made for retaining the ballast; and, when a bridge is over an highway, the floor shall be effectually waterproofed and drained.

LOADS AND STRESSES

Weight of Materials.

12. In estimating the weight of the structure for the purpose of computing the stresses therein, the following unit-weights shall be used:—

Steel	490 lbs. per cu. ft.
Concrete	150 "
Sand and gravel	100 "
Asphalt-mastic	150 "
Bituminous macadam	130 "
Paving-bricks	150 "
Spruce, white and red pine and Douglas-fir	3 lbs. per ft. B.M.
Southern long-leaf pine	4 "
Oak and birch	5 "
Creosoted timber	5 "

13. The rails and fastenings shall be assumed to weigh 150 lbs. per lineal-foot for each track.

Dead-Load.

14. The dead-load shall consist of the entire weight of metal and other materials in the structure, computed in accordance with the above unit-weights.

Live-Load.

15. The live-load for each track shall consist of two typical engines followed by an uniform train load, as shewn in appendix II and of the class specified by the purchaser's engineer.

Impact

16. Impact shall be added to the statically-computed maximum live-load stresses, as determined by the American Railway Engineering Association's formula, herewith:—

$$I = S\,\frac{30000}{30000+L^2};$$

in which I = impact stress;

S = statically-computed maximum live-load stress in member considered;

L = loaded length of track, in feet, producing the maximum live-load stress; for stringers, the loaded length shall be taken equal to that of one panel; for floorbeams, two panels.

17. Impact shall not be added to stresses produced by wind-loads or by longitudinal and centrifugal forces.

Lateral Forces

18. Fixed bridges shall be designed for an horizontal wind-force of 200 lbs. per lineal-foot, applied to both upper and lower chords; and a further horizontal force equal to 10% of the specified uniform live-load for one track, applied 8 feet above the base-of-rail; all of which forces shall be treated as moving loads, acting at right-angles to the longitudinal axis of the bridge.

19. Viaduct-towers shall be designed for an horizontal wind-force of 50 lbs. per square-foot on one and one-half times their vertical projection, when unloaded; or 30 lbs. per square-foot on the same surface, plus 10% of the specified uniform live-load on one track, applied 8 feet above the base-of-rail, either when the structure is fully loaded or loaded on any track with empty cars, assumed to weight 1,200 lbs. per lineal-foot; whichever condition produces the greater stress in any member.

Longitudinal Force.

20. Structures shall be proportioned to resist the longitudinal force produced either by the traction of the engines or by the retardation of the brakes when applied to a moving train; which longitudinal force shall be assumed to act 6 feet above the base-of-rail, and equal to a percentage of the live-load, as given by the formula:—

$$T = \tfrac{3}{4}\,(4 - L)^2 + 12;$$

in which T = longitudinal force, in percentage of the live-load;

L = loaded length, in units of 100 feet.

Centrifugal Force.

21. Structures located on curves shall be designed to resist the centrifugal force of the live-load, acting 6 feet above the base-of-rail, and computed for a speed derived from the formula:—

$$V = 60 - 2\tfrac{1}{2}\,D;$$

in which V = speed, in miles per hour;

D = degree of curve.

Eccentricity on Curves.

22. In designing either deck or through bridges for curved tracks, provision shall be made for the increased load carried by any truss-member, girder or stringer, due to the eccentricity of the load and to the effect of the centrifugal force.

Temperature Stresses.

23. Provision shall be made for stresses due to an extreme variation in temperature of 160 degrees, Fahrenheit.

Combined Stresses.

24. The various parts of the structure shall be proportioned for the maximum stresses produced by a combination of co-existing dead-load, live-load, impact and centrifugal force (if any), or for wind-load and temperature stresses (separately or combined), by using the unit-stresses herein specified; and, for any combination of stresses due to co-existing wind-load, longitudinal force or variation in temperature, with dead-load, live-load, impact or centrifugal force, the specified unit-stresses small not be exceded by more than 25%.

Alternate Stresses.

25. Whenever the dead-load and live-load stresses are of opposite character, only two-thirds of the dead-load stress shall be considered as effective in counteracting the live-load stress. Members subject to reversal of stress shall be proportioned for the dead-load stress combined with the live-load stress of the same character, together with its corresponding impact; they shall also be proportioned for two-thirds of the dead load stress combined with the live-load stress of the opposite character, with its impact; moreover, when alternate stresses of tension and compression occur in succession during the passage of one train, as in the web-members of a truss, each combination of stresses shall be increased by 50% of the smaller.

Axial and Bending Stresses Combinded.

26. Members subject to both axial and bending stresses shall be proportioned so that the combined fibre-stresses will not exceed the allowed axial unit-stress; except such members as may be subject to bending-moments from their own weight, or from eccentricity, when the total fibre-stress shall not exceed the allowed unit-stress by more than 10%; but in no case shall the section be less than required for the axial stresses alone.

27. For members continuous over panel-points and subject to transverse loading, the bending-moments, both at the panel-points and at the centre, shall be taken as three-fourths of that computed as for a simple beam, of span equal to one panel-length.

UNIT-STRESSES.

28. The following permissible unit-stresses are given in pounds per square-inch, except where otherwise noted.

Tension.

29. Axial tension on net section............16,000

Compression.

30. Axial compression
on gross section of columns...........$12{,}000 - 0.3 \left(\frac{l}{r}\right)^2$

in which l=length in inches and r=least radius of gyration in inches.

Direct compression on steel castings...........	14,000
Direct compression on iron castings...........	10,000

Bending.

31. Bending on
extreme fibres of rolled shapes, built up

sections and girders, net section...............	16,000
steel castings.............................	12,000
iron castings..............................	3,000
pins......................................	24,000
white oak, Douglas fir and southern long-leaf pine	1,600
white and red pine and spruce................	1,100

Shearing.

32. Shearing on

power-driven shop-rivets and pins.............	11,000
power-driven field-rivets......................	10,000
hand-driven field-rivets and turned-bolts......	8,000
plate-girder webs, gross section................	10,000

Bearing.

33. Bearing on

power-driven shop-rivets.....................	22,000
power-driven field-rivets and pins.............	20,000
hand-driven field-rivets and turned-bolts.......	16,000
hard bronze sliding expansion-bearings.........	1,000
expansion-rollers, per lineal inch...............	$600d$
in which d=diameter of roller, in inches.	
granite masonry............................	800
concrete, 1:2:4 mix.........................	600
limestone masonry..........................	400
sandstone masonry..........................	300

PROPORTIONING OF PARTS.

Net Section at Rivet-Holes.

34. In proportioning rivetted tension members, the diameter of the rivet-holes shall be taken one-eighth (1/8) inch larger than the nominal diameter of the rivet; and allowance shall be made in each component part of the member for as many rivet-holes as it contains gauge-lines, unless the distance centre to centre of rivet-holes, measured on the diagonal, is at least 40% greater than the distance between the gauge-lines. In every angle, allowance shall be made for at least two rivet-holes.

Net Section at Pin-Holes.

35. In pin-connected rivetted tension members, the net section, both through the pin-hole and back of same, shall exceed the net section of the body of the member by at least 25%.

Limiting Length of Compression Members

36. No compression or stiffening member shall have a length exceeding 175 times its least radius of gyration; but, for built-up I–sections, the radius of gyration may be computed for the flange materials alone, neglecting the web-plate, in which case the latter shall not be counted on as effective section for axial stresses.

Open Sections.

37. Structures shall be so designed that all parts will be accessible for inspection, cleaning and painting.

Water-Pockets.

38. Pockets or depressions shall be avoided as far as possible; and those which are unavoidable shall either be provided with effective drain-holes, or they shall be filled with waterproof material.

Symmetrical Sections.

39. Main members shall be so designed that their neutral axis will be as nearly as practicable in the centre of the section; and the neutral axes of interesting main members shall meet in a common point.

Minimum Sections.

40. Unless otherwise specified by the engineer, the minimum thickness of metal shall be ⅜ inch, except for fillers.

Plates in Compression.

41. Cover-plates and web-plates of built compression members, also flange-plates of girders, shall have a minimum thickness of

$$t = \frac{pd}{400{,}000};$$

in which t = minimum thickness of metal, in inches;
p = axial unit-stress, in lbs. per sq. in.;
d = unsupported distance between connections to flanges, or distance between rows of connection rivets, in inches.

Outstanding Flanges.

42. Unstiffened flanges of compression members and griders shall have a minimum thickness of

$$t = \frac{pl}{120{,}000};$$

in which t = minimum thickness of metal, in inches;
p = axial unit-stress, in lbs. per sq. in.;
l = unsupported length of outstanding leg, in inches.

Counters.

43. Rigid counters are preferred. Adjustable counters, when used, shall have open turnbuckles.

Pony-Truss Bridges.

44. Pony-truss bridges shall be of rivetted type; they shall have double-webbed chords, and latticed or otherwise effectually stiffened web-members.

45. In all pony-truss bridges, the floorbeams shall be rigidly connected to vertical truss members; and stiffening gussets, as large as practicable without interfering with the required clearances, shall be provided. The vertical truss members and the floorbeam connections thereto shall, when practicable, be proportioned to resist, at the specified unit-stresses, a lateral force applied at the top chord of the truss, equal to 2% of the maximum top-chord stress. When impracticable to design the vertical truss members sufficiently strong to meet this requirement, outside wing braces shall be added.

Plate-Girders.

46. Plate-girders shall be proportioned for bending-moments either by the moment of inertia of their net section, or by assuming that the flanges are concentrated at their centre of gravity. In the latter case, one-eighth of the gross section of the web-plate shall be assumed as equivalent net section for the tension flange.

Compression Flanges.

47. The gross section of the compression flange of plate-girders shall not be less than that of the tension flange; nor shall the stress per square-inch in the compression flange of any beam or girder exceed $16{,}000 - 200\frac{l}{b}$ lbs.

where l = the unsupported length, in inches, and b = the width of the flange, in inches.

Flange-Plates.

48. When flange-plates are used on plate-girders, they shall extend not less than one foot beyond the point where any portion of their section is needed to make up the required flange area; and one plate on the top flange shall extend the full length of the girder.

Web-Plates.

49. Splices in web-plates shall be avoided as far as possible; but, when necessary, they shall be designed so that the full value of the web-plate will be uniformly developed, both for bending and for shear.

Web Stiffeners.

50. There shall be web stiffeners, generally in pairs; over bearings and at points of concentrated loading. Intermediate stiffeners shall be provided when the thickness of the web-plate is less than one-sixtieth (1/60) of the unsupported distance between flange-angles, spaced in accordance with the formula given below; but the clear distance between stiffeners shall not exceed 6 feet, nor shall it exceed the clear depth of the web-plate, measured between flange-angles:—

$$d = \frac{t}{40}(12{,}000 - s);$$

in which d = clear distance, in inches, between stiffeners;
t = thickness of web-plate, in inches;
s = shear per square-inch.

51. Stiffeners at end bearings and at points of concentrated loading shall be proportioned as columns, with an unit-stress of 12,000 lbs. per square-inch; they shall be on fillers, and their outstanding legs shall be as wide as the horizontal legs of the flange-angles on which they bear (inside measurement). Intermediate stiffeners may be offset or on fillers, and their outstanding legs shall have a width of not less than one-thirtieth (1/30) of the depth of the girder, plus two (2) inches.

Floorbeams.

52. Floorbeams shall preferably be set at right-angles to the trusses or main girders, and shall be rigidly connected thereto; except in the case of deck bridges, where the floorbeams may rest upon the top chords, if permitted by the engineer. End floorbeams shall be provided, when possible; and they shall preferably be designed for jacking-up the bridge, if necessary, under which condition the allowed unit-stresses shall not be exceeded by more than 50%.

End-Struts.

53. When impossible to use end floorbeams with through bridges, end-struts and stringer cross-frames shall be provided, which shall be rigidly connected to the stringers and to the trusses or main girders.

Bracing.

54. Lateral, longitudinal and transverse bracing shall be rigid, and shall be proportioned, 1st, so that the unsupported length thereof will not exceed 175 times the least radius of gyration; 2nd, so that the fibre-stress resulting from their own weight will not exceed the allowed axial unit-stress for compression; 3rd, so that the fibre-stress resulting from their own weight, combined with any computed axial stress, will not exceed the allowed axial unit-stress for tension or compression, as the case may be.

55. Through-truss bridges shall be provided with portal bracing, rigidly connected to the end-posts and top chords; it shall be proportioned for the total specified wind-load on the top chords, and shall be as deep as the specified clearance will allow. Furthermore, sway-bracing shall be provided at all intermediate principal verticals; or, in the case of lattice trusses having no intermediate vertical members, on all principal compression web-members. Sway-bracing shall also be as deep as the specified clearance will allow.

56. Deck bridges shall be provided with transverse bracing at the ends, proportioned for the total specified wind-load on the top chords; also transverse bracing at all intermediate principal verticals; or, in case there are no full-depth intermediate verticals, on all principal compression web-members.

57. Viaduct-towers shall have at their base both transverse and longitudinal struts, proportioned to slide the movable shoes when the structure is unloaded.

58. Through plate-girders shall have their top flange stayed at each floorbeam; or in case of solid floors, at distances not exceeding 12 feet, by knee-braces or gussets.

DETAIL OF DESIGN.

Eye-Bars.

59. Adjacent eye-bars of a member shall be so arranged that their surfaces will not be in contact. Eye-bars shall be as nearly as possible parallel to the plane of the truss, with a maximum inclination of one inch in 16 feet.

Pin-Plates.

60. Pin-plates shall be of sufficient thickness to make up the required bearing area on the pin; they shall be as wide as the dimensions of the member will allow; and their length, measured from pin-centre to end, shall be at least equal to their width. Pin-plates shall contain sufficient rivets to distribute their due proportion of the pin pressure to the full cross-section of the member; and only the rivets located in front of two lines, intersecting at the pin-centre and inclined at 45 degrees to the axis of the member, shall be considered effective for this purpose. In case of members composed of web-plates and flange-angles (with or without a cover-plate), there shall be at least one outside pin-plate, covering the vertical legs of the flange-angles.

Forked Ends.

61. Forked ends on compression members will only be permitted when unavoidable; but when used, a sufficiency of pin-plates shall be provided to make the jaws of twice the sectional area of the member. At least one of these pin-plates shall extend to the far edge of the farthest tie-plate, and the balance shall extend to the far edge of the nearest tie-plate, but not less than 6 inches beyond the near edge of the farthest tie-plate.

Pins.

62. Pins shall be long enough to insure a full bearing thereon of all the parts connected thereby. They shall be secured either by chambered nuts or by solid nuts provided with washers. The screw-ends shall be long enough to admit of burring the thread.

Filling-Rings.

63. Filling-rings shall be provided, where necessary, to prevent lateral movement on pins of the members connected thereby.

Effective Diameter of Rivets.

64. In calculating the number of rivets required, the nominal diameter only, or size of the cold rivet before driving, shall be taken as effective.

Pitch of Rivets.

65. The minimum distance between centres of rivets shall be three times the diameter of the rivet; but, preferably, 3 inches for ⅞-inch rivets, 2½ inches for ¾-inch rivets, and 2¼ inches for ⅝-inch rivets. In members composed of plates and angles, the maximum rivet-pitch in line of stress shall be 6 inches. In built tension members, the rivet-pitch shall not exceed sixteen times the thickness of the thinnest plate or angle, except in angles having two lines of staggered rivets, where the pitch on each line may be twice this limit. In built compression members, the rivet-pitch shall not exceed twelve times the thickness of the thinnest outside plate or angle, except in angles having two lines of staggered rivets, where the pitch on each line may be one and one-half times this limit.

Rivets at Ends of Compression Members.

66. In built compression members, the rivet-pitch at the ends shall not exceed four times the diameter of the rivet for a length equal to one and one-half times the maximum width of the member; except in angles having two lines of rivets, staggered, where the pitch on each line may be twice this limit, but not greater than that allowed for the body of the member.

Flange Rivets.

67. The number of rivets connecting flange-angles of plate-girders to the web-plate shall be sufficient to develop the increment of flange stress, combined with any load applied to the flange; and the maximum pitch in the vertical legs of the loaded flange-angles shall not exceed 4 inches on a single line, or 8 inches when there are two lines of rivets, staggered.

Rivets in Wide Flange-Plates.

68. When two or more flange-plates are used, and which project more than 3 inches beyond the edge of the flange-angles, an extra line of rivets shall be driven along each edge; spaced not more than sixteen times the thickness of the thinnest outside plate, for the tension flange; nor more than twelve times the thickness of the thinnest outside plate, for the compression flange.

Edge-Distance of Rivets.

69. The minimum distance from the centre of any rivet to a sheared edge shall be 1½ inches for ⅞-inch rivets, 1¼ inches for ¾-inch rivets and 1⅛inches for ⅝-inch rivets; and, to a rolled or planed edge, 1¼, 1⅛ and 1 inches, respectively. The maximum edge-distance for rivets shall be eight times the thickness of the thinnest outside plate, but not more than 6 inches.

Maximum Diameter of Rivets.

70. The diameter of the rivets in any angle, channel or beam subject to calculated stress shall not exceed one-quarter of the width of the leg in which they are driven. In minor parts, ⅞-inch rivets may be used in 3-inch legs; ¾-inch rivets in 2½-inch legs; and ⅝-inch rivets in 2-inch legs.

Long Rivets.

71. Rivets subject to calculated stress, and whose grip exceeds four diameters, shall be increased in number at least one per cent. for each additional one-sixteenth-inch grip.

Turned-Bolts.

72. Turned-bolts may only be used in place of rivets by special permission of the engineer.

Strength of Connections.

73. Tensions members shall be connected or spliced for an axial stress equal to their net sectional area, in square-inches, multiplied by 16,000 lbs. per square-inch. Compression members shall be connected for an axial stress equal to their gross sectional area, in square-inches, multiplied by 12,000 lbs. per square-inch. Truss members subject to reversal of stress, shall be connected for an axial stress equal to the numerical sum of the stresses. Lateral, longitudinal and transverse bracing, when subject to reversal of stress, shall be connected for their maximum value, whether in tension or compression.

Compression Splices.

74. Compression members abutting on a pin shall have sufficient bearing thereon to transmit the entire thrust without exceeding the allowable unit-bearing. In rivetted structures, continuous compression members, such as chords and trestle-posts, shall have faced ends and full contact-bearings at the joints when rivetted. All joints in compression members, where pins are not used, shall be spliced for an axial stress equal to the gross sectional area of the smaller abutting member, in square-inches, multiplied by 12,000 lbs. per square-inch.

Minimum Connections.

75. No member or component part thereof, except lattice-bars, shall be spliced or connected by fewer than 3 rivets.

Indirect Splices.

76. Where splice-plates are not in direct contact with the parts which they connect, the number of rivets therein, which would otherwise be required for a contact-splice, shall be increased by 10% for each intervening plate.

Fillers.

77. Rivets carrying stress and passing through fillers shall be increased in number by 20%; and the additional rivets, when possible, shall be outside of the connected member.

Arrangement of Splice Materials.

78. The materials for splices shall be so arranged that the strength of each component part of the member spliced, including legs of angles, flanges and webs of beams and channels, etc., will be fully developed.

Tie-Plates and Diaphragms.

79. The open sides of compression members shall be provided with tie-plates, placed as near the ends as practicable; and, if located farther from the intersection-point than twelve times the width of the outstanding flanges, diaphragms shall be added. Tie-plates shall also be provided at intermediate points where the latticing may be interrupted.

80. In main members, the end tie-plates shall have a length of not less than one and one-half times, and intermediate tie-plates, a length of not less than the perpendicular distance between the lines of rivets connecting them to the flanges; their thickness shall not be less than one-fiftieth (1/50) of the distance between connecting lines of rivets.

81. When intermediate tie-plates are used with tension members instead of latticing, they shall be spaced not farther apart in the clear than fifteen times the width of the flange to which they are attached, and they shall be connected to the member by not fewer than 3 rivets on each side.

Latticing.

82. The latticing of compression members shall be proportioned to resist a cross shear equal to 2% of the axial stress in the member, which shear shall be considered as divided equally among all stiffening parts in parallel planes, whether of continuous plates or of latticing.

Minimum Size of Lattice-Bars.

83. The minimum width of lattice-bars shall be $2\frac{1}{2}$ inches for $\frac{7}{8}$-inch rivets, $2\frac{1}{4}$ inches for $\frac{3}{4}$-inch rivets, and 2 inches for $\frac{5}{8}$-inch rivets. The minimum thickness shall be one-fortieth (1/40) of the distance between end rivets, in the case of single latticing; and one-sixtieth (1/60) of this distance for double latticing, rivetted at the intersections. Shapes of equivalent strength may be used instead of flats.

Inclination and Spacing of Lattice-Bars.

84. Lattice-bars shall generally be inclined at an angle of about 60 degrees to the axis of the member, when single latticing is used; and they shall be inclined at an angle of not less than 45 degrees, with double latticing; furthermore, the maximum spacing of lattice-bars shall be such that the ratio l/r for the portion of single flange included between consecutive connections will be smaller than this ratio for the member as a whole.

Expansion.

85. Provision for expansion, to the extent of one inch for each 80 feet, shall be made for all bridge structures. Spans of less than 100 feet may be arranged to slide upon steel plates with smooth surfaces; but spans of 100 feet and over shall be provided with turned rollers or rockers, or with special sliding bearings, as described below.

Roller-Bearings.

86. Expansion-rollers shall not be less than 4 inches in diameter; they shall be connected together by substantial side-bars, and shall be effectually guided so as to prevent lateral movement, skewing or creeping. The rollers and bearing-plates shall be protected from dirt and water, as far as possible, by suitable curtain-plates; and the whole construction shall be such that water will not be retained therein, and that it may be easily inspected and cleaned.

Neither rollers nor rockers shall be used for expansion-bearings at the top of trestle-posts.

Special Siding Bearings.

87. Sliding plates for the expansion-bearings of spans of 100 feet and over shall be of hard bronze, or of some other hard non-corrosive material; they shall be chamfered at the ends, and shall be securely held in position; furthermore, they shall be so arranged that the sliding surfaces thereof cannot become clogged by dirt.

Fixed Bearings.

88. Fixed bearings shall be firmly anchored to the masonry.

Pier-Members.

89. Spans of 100 feet and over shall preferably rest upon hinged or disc bearings, which shall be constructed so as to distribute the load evenly over the entire bearing. Bed-plates may be castings, or they may be of rolled steel.

Anchor-Bolts.

90. Anchor-bolts shall not be less than one and one-quarter ($1\frac{1}{4}$) inches in diameter.

Anchorage.

91. Anchor-bolts for viaduct-towers and similar structures shall be long enough to engage a mass of masonry weighing not less than one and one-half ($1\frac{1}{2}$) times the amount of the net uplift.

Camber.

92. Trusses shall be cambered, either by increasing the length of the top chord $\frac{1}{8}$ inch per 10 feet; or by so modifying the length of members that the floor-line will be straight when the bridge is fully loaded.

MOVABLE BRIDGES.

Types.

93. Movable bridges may be classified, in a general manner, as follows:—

(*a*) Swing-bridges, which revolve about a vertical axis;
(*b*) Bascule-bridges, which lift at one end;
(*c*) Rolling-bridges, which move horizontally;
(*d*) Lift-bridges, which move vertically;
(e) Pontoon-draw-bridges, which float on pontoons;

and the type to be adopted for a particular location shall be as specified by the engineer.

Waterway.

94. The minimum clear width of waterway, and the clear height above the water when the bridge is open, shall be as specified by the engineer.

Structural Parts.

95. The structural parts of movable bridges shall be designed in accordance with the requirements herein specified for steel bridges generally, except as modified hereinafter. In proportioning members subject to bending from pin-friction, eccentric connections or other causes, the computed bending stress shall be increased by 25%; and the total fibre-stress, resulting from combined axial and bending stresses, shall not exceed the allowed axial unit-stress.

Alternate Dead-Load Stresses.

96. Members subject to alternate stresses of tension and compression, during the operation of the bridge, shall further be proportioned for either of these stresses, increased by 50% of the smaller; and the connections shall be proportioned for the sum thereof.

Machinery Connections.

97. Members to which machinery is attached, as well as other members affected thereby, shall be designed to meet the maximum force which can be exerted by the motive power, either specified or supplied, or by the maximum force due to retardation by the brakes.

Wind-Loads.

98. The machinery, machinery-supports and motive power shall be designed for the following wind-loads:—

(a) an horizontal wind pressure of 15 lbs. per square-foot on the vertical projection of all exposed surfaces of the movable structure, acting in any horizontal direction and at any period during the operation of the bridge;

(b) an horizontal wind pressure of 5 lbs. per square-foot on the vertical projection of all exposed surfaces of either arm of a swing-bridge, acting at right-angles to the longitudinal axis of the bridge;

(c) a vertical wind pressure of 5 lbs. per square-foot, acting on the horizontal projection of all exposed surfaces of bascule and vertical-lift bridges;

(d) an horizontal wind pressure of 30 lbs. per square-foot on the vertical projection of all exposed surfaces of the movable structure, acting in any horizontal direction and at any period during the operation of the bridge.

Swing-bridges shall be designed to operate, at the specified speed, under condition (a); they shall be designed to operate, at reduced speed, under conditions (a) and (b) combined; and to be safe against movement under conditions (b) and (d) combined. Bascule and vertical-lift bridges shall be designed to operate, at the specified speed, under condition (a); at reduced speed, under conditions (a) and (c) combined; and to be safe against movement under conditions (c) and (d) combined. All movable bridges, when closed and locked, shall be designed for the same wind-loads as equivalent fixed spans.

Time for Opening

99. The maximum time for opening the bridge, after the ends have been released, shall be as specified by the purchaser's engineer, both for the main and auxiliary powers.

Angle of Rotation.

100. The angle of rotation for swing-bridges shall be as specified by the purchaser's engineer.

Stresses for Swing-Bridges.

101. In computing the stresses for swing-bridges, continuous over three or four supports, the following cases shall be considered:—

Case I. Dead-load, bridge swinging; or closed, with ends just touching supports;

Case II. Dead-load, bridge closed, with ends lifted sufficiently to produce the full reaction, computed as for a continuous girder;

Case III. Live-load on closed bridge, placed so as to give maximum stresses of tension and compression in every member.

102. The following combinations of stresses shall be considered; and the various members shall be proportioned for that combination which requires the greatest section, taking into account the impact and provision for reversals, specified in the general section relating to Loads and Stresses.

Case I, plus 25% for impact;

Case I with Case III and impact;

Case II with Case III and impact.

Turntables.

103. Turntables for swing-bridges may be centre-bearing, rim-bearing, or a combination of the two.

Centre-bearing Turntables.

104. Centre-bearing turntables shall be designed so that the entire dead-load of the bridge, when swinging will be carried on the centre pivot. When the bridge is closed, the trusses or main girders shall be supported at the pivot-pier by wedges or otherwise to provide for the live-load reaction; except in the case of narrow bridges, for which such supports may be omitted, provided that the transverse loading-girder shall be designed to carry both dead-load and live-load. Balance-wheels, running on a circular track, shall be provided for the purpose of balancing the bridge while swinging; which balance-wheels and their supports shall be designed to resist the overturning effect of the specified wind-load, together with an assumed unbalanced load on one end of the bridge, equal to one-half of one per cent. (0.5%) of the total weight of the movable structure, but in no case less than 3,000 lbs.

Rim-Bearing Turntables.

105. In the case of rim-bearing turntables, the loading and distributing girders shall be designed so as to distribute the total dead-load and live-load thereon equally among all of the rollers. When a circular girder or drum is used, it shall preferably be loaded at not fewer than eight equidistant points; all splices therein shall be sufficient to develop the full strength of the materials spliced; abutting ends shall be faced; and the bottom shall have a planed surface, centrally located with the web, and of sufficient area to transmit the load thereon to the upper tread without exceeding the allowed unit-bearing.

Treads and Tracks.

106. Upper and lower treads for rim-bearing turntables and tracks for centre-bearing turntables shall be designed sufficiently strong and stiff to distribute the maximum roller or balance-wheel load to the adjacent drum or masonry, without exceeding the allowed unit-bearings thereon; bearing surfaces and abutting ends shall be planed. Lower treads and tracks shall be securely anchored to the masonry, and connected to the centre pedestal casting.

Rollers and Balance-Wheels.

107. Rollers and balance-wheels shall be proportioned so that the allowed bearing thereon will not be exceeded; and shall be turned so as to roll freely on the treads or track. Rollers for rim-bearing turntables shall be effectually held in their relative position by stiff spacing-rings, connected to and revolving about the centre pedestal; and they shall be adjustable, radially. Balance-wheels shall be adjustable, vertically.

Rack-segments.

108. Rack-segments shall be steel or iron castings; they shall be machined at connections to supports and on the ends, and shall be securely fastened to the lower tread or track, or to the masonry. The fastenings for each segment (including connections to the adjoining segments) shall be sufficient to develop at least twice the full strength of one rack-tooth.

Centre Pedestal Casting.

109. The centre pedestal casting shall be of steel or iron, and shall be proportioned for both strength and rigidity; it shall be turned, where necessary, concentric with the axis, and faced on the bottom truly at right-angles to same. It shall be securely anchored to the masonry.

Pivot and Discs.

110. The pivot casting shall be of steel or iron, and shall be supported upon three discs: one of phosphor-bronze between two of hard tool-steel, so designed that the tool-steel will rotate on the phosphor-bronze. The steel discs shall be oil-tempered; and all shall be turned, accurately ground and finished to a high polish. The pivot and discs shall be effectually held, laterally, to resist the specified wind-force on the bridge while swinging, without depending upon the strength of bolts in shear; and provision shall be made for their removal, without jacking-up the structure more than is necessary to take off the load.

End-Lifts.

111. Swing-bridges shall be provided with effective end-lifts, capable of exerting an upward force exceeding the maximum negative live-load reaction by at least 25%, and having a bearing capacity equal to the maximum positive reaction. Where wedges are used in this connection, the actuating mechanism shall be non-reversible and of sufficient strength to prevent the wedges from backing out, no allowance being made for frictional resistance on wedge surfaces.

Aligning and Locking.

112. Movable bridges shall be provided with suitable mechanism for aligning them accurately and for securing them against displacement, either horizontally or vertically, under the action of the live-load. In the case of swing-bridges, the aligning mechanism may be an automatically-closing latch, or a suitable aligning and locking device, operated by the end-lift mechanism or otherwise; and, when there are guard-piers, provision shall be made for securing the bridge thereto when open.

Stresses for Bascule Bridges.

113. In computing the stresses for bascule-bridges, the following conditions or cases of loading shall be considered:—

- Case I. Dead-load, bridge closed;
- Case II. Dead-load, bridge in any position which may give maximum stresses of tension and compression in every member;
- Case III. Wind-load of 30 lbs. per square-foot on the vertical projection of all exposed surfaces of the entire structure, acting in any horizontal direction and at any period during the operation of the bridge.
- Case IV. Live-load on closed bridge, placed so as to give maximum stresses of tension and compression in every member.

114. The following combinations of stresses shall be considered; and the various members shall be proportioned for that combination which requires the greatest section:—

- Case I with Case IV, including impact and the specified increase on account of alternate stresses;
- Case II, plus 25% for impact, and increased for alternate stresses as herein specified;
- Case II with Case III, no impact and no consideration for alternate stresses.

Counterweight Supports

115. Steel towers and other parts of the structure which support the counterweight shall be proportioned to resist, in addition to the vertical loads thereon, a horizontal force, in any direction, equal to the specified wind-load; or equal to 5% of the supported load, applied at its centre of gravity.

Counterweight Reinforcing.

116. In proportioning reinforcing members, embedded in the counterweight for supporting or transferring the load to the main structure, provision shall be made for reversals of stress as specified for alternate dead-load stresses, together with an impact allowance of 25%.

Other Types of Movable Bridges.

117. The stresses for other types of movable bridges shall be computed for the various conditions of loading incident thereto; and the members thereof shall be proportioned for combinations of stresses, generally in accordance with conditions herein governing the design of fixed, swing and bascule bridges, or as may be specified by the engineer.

Toothed Gearing.

118. Gears may be of steel, cast-iron or bronze; they shall preferably have machine-cut teeth of the standard fifteen-degree involute type, with addendum equal to 0.318 and dedendum equal to 0.368 of the circular pitch. The teeth shall be designed on the assumption

that the entire load is taken by one tooth, applied at the end thereof and uniformly distributed throughout its length. The face of cut gears shall not exceed five times and, of uncut gears, three times the circular pitch. For rack and pinion gearing and similar cases, special forms of teeth, designed to secure greater strength, may be used.

Worm-Gearing.

119. In worm-gearing, the worm and wheel shall be made of different metals; generally, the former shall be of steel and the latter of phosphor-bronze or cast-iron. Worm-gearing shall be cut; and the strength of the teeth of the wheel shall be computed in the same manner as for ordinary toothed gearing. In all cases, special provision shall be made for lubrication, by enclosing both worm and wheel in a tight casing, preferably cast with the bearings, and with provision for an oil-bath for either the worm or wheel.

Shafting.

120. Shafting may be of cold-rolled, bar or forged steel. Line shafting shall not be less than one and fifteen-sixteenths inches in diameter; and the bearings for same shall be spaced not over sixty diameters apart. All gearing, couplings or other attachments shall be close to bearings. Shafting shall be designed for combined bending and torsion, in accordance with the formula for equivalent bending-moment, herewith:—

$$M^1 = \tfrac{1}{2}\,(M + \sqrt{M^2 + T^2});$$

in which M^1 = equivalent bending-moment;
M = bending-moment;
T = twisting-moment, or torque.

121. Provision shall be made for the weakening effect of keyways, assuming that one keyway, or two keyways at right-angles to one-another, will reduce the section-modulus of the shaft, in bending, to 83% of its original value, and that two keyways opposite one-another will reduce it to 75%. These reductions are for a width of key equal to one-fourth and for a depth of keyway equal to one-eighth of the diameter of the shaft. Wider keys and deeper keyways shall not be used. At all points where the diameter of a shaft is changed, a fillet shall be used, which shall be as large as possible.

Collars.

122. Effectual means for preventing longitudinal movement of shafting shall be provided, such as a split-collar clamped in a cut groove, or a substantial pin or bolt passing through a collar or through the hub of an attached part. Collars with set-screws may be used only in case there is no definite longitudinal force to be resisted.

Keys.

123. All parts transmitting torsion to shafts shall be fastened thereto by keys. The width of keys shall be approximately one-fourth of the diameter of the shaft; and their thickness, about two-thirds of their width; they shall be tapered ⅛ inch to a foot, and shall be provided with gib-heads wherever possible. When two keys are used, they shall not be placed opposite one-another, except in cases where the keyed part is required to slide along the shaft, when two parallel and opposite keys shall be used.

Bearings.

124. Bearings, generally, shall be of cast-iron, except where steel is required for strength. All steel bearings, and cast-iron bearings subject to heavy duty or fast-running shafts, shall be babbitted, or lined with some other suitable material, preferably bronze.

Axles.

125. Axles for balance-wheels shall either be fixed in the wheel and turn in the bearings; or fixed in the bearings, with the wheel turning. In the latter case, the hub of the wheel shall be of such length that a normal to the wheel-tread, at any point, will fall well within the limits of the rotating bearing on the axle.

Set-Screws.

126. Set-screws and tap-bolts shall not be used for any important fastening.

Operating Power.

127. Movable bridges may be operated by hand-power only, or by both hand and mechanical power, depending upon local conditions, and as specified by the purchaser's engineer.

Hand-power.

128. In the case of hand-power, the number of men and the time required to operate the bridge shall be estimated on the assumption that one man will push 40 lbs. on the turning-lever while walking at a speed of 160 feet per minute. In proportioning the machinery parts, it shall be assumed that there will be at least two men on each handle of the turning-lever, pushing 75 lbs. each.

Mechanical Power.

129. If the bridge is to be operated by mechanical power, the motor shall be of ample capacity to perform its duty at the required speed. All machinery parts, including connections and supports therefor, shall be proportioned, at the specified unit-stresses, for the rated power of the motor, increased by 100% for impact. No matter what mechanical power may be used, all movable bridges shall also be provided with hand-power operating machinery. The arrangement and details of the machinery, construction and location of the operator's cabin, and any other details connected with the mechanical operating power, shall be subject to the approval of the purchaser's engineer.

130. The contractor shall in all cases supply the purchaser's engineer with the performance-curve of the motor to be used. In the case of electric-power, a direct-current motor of 220 volts shall be given preference; although a polyphase alternating-current motor, of the wound rotor type and of not over 550 volts, may be used. All electric motors shall be provided with safety devices, designed to prevent excessive over-loading; and the entire electrical equipment shall be installed in accordance

with requirements of the authorities having jurisdiction in such matters. When steam-power is used, the contractor shall supply the engineer or owner with such certificates of inspection as may be required by the local authorities. In all cases, the motor, of whatever form, shall be of a well-known make.

Operating Machinery.

131. The operating machinery of movable bridges shall be designed and constructed in a substantial manner, and shall be free from complicated and flimsy contrivances. All parts shall be arranged so that they may be easily erected, adjusted and taken apart; and they shall be accessible for inspction, cleaning and repairs. Fastenings shall be designed so that, when all machinery parts are properly set, lined and adjusted, they will be permanently fixed.

132. Hand-power machinery shall be arranged so that the lever for operating the end-lifts and for swinging the bridge will be applied as near the centre pivot as practicable.

133. When mechanical power is used, the operating-machinery shall be provided with effective brakes, to hold the bridge against the specified wind-loads, or to bring it to rest in the time allowed in the calculations. In estimating the effect of the brake on all parts of the mechanism, including the rack and members of the structure to which machinery is attached, frictional resistances which assist the brake shall be added, using maximum values. In determining the loss of power due to friction, the efficiency of cut gears shall be taken at 98%; of uncut gears, 85%; the coefficient of friction for journals shall be taken at 10%; for wedges, 15% on the top surface and 20% on the bottom.

Unit Stresses, Machinery Parts.

134. Machinery parts shall be designed in accordance with the permissible unit-stresses, in lbs. per square-inch, given in table I, below. In applying these unit-stresses, as well as the formulae for strength of gear-teeth, given in the following paragraph, the computed loads and stresses shall be increased for impact by doubling the maximum motor torque and the maximum effect of the brakes, plus friction. When two or more parts are operated from the same shaft, such as rail-locks or end-lifts, and one such part, if jammed, may absorb an undue portion of the power, full allowance shall be made therefor.

TABLE I. UNIT-STRESSES, MACHINERY PARTS

Kind of Stress	Structural Steel	Rolled Steel Shafting	Forged Steel Shafting	Steel Castings	Iron Castings	Brass
Axial Tension	16,000	16,000	20,000	12,000	....	......
Direct Compression	14,000	14,000	17,500	14,000	10,000	3,000
Bending.....	16,000	12,000	15,000	12,000	3,000	3,000
Shear........	10,000	10,000	12,000	10,000	3,000	3,000

Strength of Gear-Teeth.

135. The strength of fifteen-degree involute gear-teeth shall be determined by the formulae below. Unit-stresses for speeds between those given to be obtained by interpolation. Other forms of gear-teeth shall be proportioned so that their maximum fibre-stress in bending will not exceed the unit-stresses given in Tables II and III.

$$P = s\,p\,f\,y, \text{ for plain gears;}$$

$$P = s\,p\,f\,y\,\frac{d}{D}, \text{ for bevel gears;}$$

in which P = maximum load on tooth, in pounds;
s = unit-stress for bending, as given in Tables II and III;
p = pitch of teeth, in inches;
f = face of tooth, in inches;
y = strength-factor, depending upon the form of the tooth, as given in Table IV;
d = small pitch-diameter of a bevel-gear;
D = large pitch-diameter of same bevel-gear.

TABLE II. UNIT-STRESSES s FOR CAST-IRON AND BRONZE GEAR-TEETH

	Speed of teeth, in feet per minute.							
	100 or less	200	300	600	900	1,200	1,800	2,400
Cut Teeth.	8,000	6,000	4,800	4,000	3,000	2,400	2,000	1,700
Cast Teeth	4,000	3,000	2,400	....	....	...	...	..

TABLE III. UNIT-STRESSES s FOR STEEL GEAR-TEETH

	Speed of teeth, in feet per minute.							
	100 or less	200	300	600	900	1,200	1,800	2,400
Cut Teeth.	20,000	15,000	12,000	10,000	7,500	6,000	5,500	4,300
Cast Teeth	10,000	7,500	6,000	...	.		..	.

TABLE IV. STRENGTH-FACTOR y FOR FIFTEEN-DEGREE INVOLUTE TEETH

No. of Teeth	Factor	No. of Teeth	Factor	No. of Teeth	Factor	No. of Teeth	Factor
12	0.067	18	0.083	27	0.100	60	0.114
13	0.070	19	0.087	30	0.102	75	0.116
14	0.072	20	0.090	34	0.104	100	0.118
15	0.075	21	0.092	38	0.107	150	0.120
16	0.077	23	0.094	43	0.110	300	0.122
17	0.080	25	0.097	50	0.112	Rack.	0.124

Moving Bearings.

136. The bearing-values, in lbs. per square-inch, to be used for rotating and sliding surfaces where the speed is slow and intermittent, are as follows:—

Pivots for swing-bridges, hardened tool-steel on phosphor-bronze..........................	3,000
Trunnion-bearings for bascule-bridges, forged steel on phosphor-bronze.......................	1,200
Wedges, cast-iron on bronze....................	600
Wedges, cast-iron on cast-iron or steel...........	500
Screws which transmit motion..................	200
Steel journals on bronze bushings...............	1,000
Steel or iron journals on No. 1 babbitt-metal bushings..................................	800
Steel or iron journals on No. 2 babbitt-metal bushings..................................	600
Steel or iron journals on No. 3 babbitt-metal bushings..................................	400

Where necessary, higher pressures may be used, provided that special precautions are taken with respect to finishing and lubrication; but only with the express approval, in writing, of the purchaser's engineer.

137. In order to prevent heating and seizing at higher speeds, the pressure per square-inch on pivots, foot-step-bearings for vertical shafts and on journals shall not exceed:

$$p = \frac{160{,}000}{n\,d}, \text{ on pivots;}$$

$$p = \frac{300{,}000}{n\,d}, \text{ on journals;}$$

in which p = pressure per square inch;
n = number of revolutions per minute;
d = diameter of pivot or journal, in inches.

138. For crank-pins and similar parts with alternating motion, the limiting bearing-value, as derived from the above formula for journals, may be doubled; but it shall not exceed the limit herein specified for slow speeds.

Roller-Bearings.

139. The maximum bearing, in lbs. per lineal-inch, on rollers in motion, shall be as follows:—

Cast-iron	200 d
Cast-steel	600 d
Forged steel	750 d
Tool-steel	1,200 d
Hardened tool-steel	1,500 d

in which d = diameter of roller, in inches. The above values are for roller and bearing surfaces of the same material; if of different materials, the lower value shall be used.

Rail-Locks and Signals.

140. When specified, suitable rail-locks and interlocking signals shall be provided. The rail-locks shall be made of manganese, vanadium, axle or other approved kind of steel, which will bear hardening to resist wheel-wear. Both rail-locks and interlocking signals shall be subject to the approval of the purchaser's engineer.

Patents.

141. The contractor shall fully indemnify and save harmless the purchaser against all loss or damage, claims and demands, cost and charges, which may arise or accrue by reason of the adoption or use by the contractor of any patented article, device or improvement furnished by him, except when such patented article, device or improvement has been adopted at the request or on the recommendation of the purchaser's engineer.

WORKMANSHIP.

General.

142. All parts forming a structure shall be built in accordance with approved drawings. The workmanship and finish shall be equal to the best practice in modern bridge works. Material shall have clean surfaces before being worked in the shop.

Straightening.

143. Material shall be thoroughly straightened in the shop, by methods that will not injure it, before being laid off or worked in any way.

Finish.

144. Shearing and chipping shall be neatly and accurately done, and all portions of the work exposed to view shall be neatly finished. When specified by the purchaser's engineer, sheared edges of all splice and connection plates for main members, and of all material over ⅝-inch thick, shall be planed at least ⅛-inch.

Lattice-bars.

145. Lattice-bars shall have neatly rounded ends, unless otherwise called for.

Rivet-holes.

146. Rivet-holes in main members shall either be drilled from the solid, or sub-punched and reamed. In lateral and sway-bracing and in secondary parts, such as tie-plates, lattice-bars, stiffeners, etc., rivet-holes may be punched full size.

Punched Holes.

147. Where reaming is not required, the diameter of the punch shall not be more than one-sixteenth (1/16) inch greater than the nominal diameter of the rivet; nor the diameter of the die more than one-eighth (⅛) inch greater than that of the punch. Punching shall be accurately done. Drifting, to enlarge unfair holes, will not be allowed. If holes must be enlarged to admit the rivets, they shall be reamed. Poor matching of holes will be cause for rejection.

Reamed Holes.

148. In the case of sub-punching and reaming, the diameter of the punch shall be not less than three-sixteenths (3/16) inch smaller than the nominal diameter of the rivet; and the holes shall be reamed to a diameter not more than one-sixteenth (1/16) inch greater than the nominal diameter of the rivet. The holes, before being reamed, shall match with sufficient accuracy so that at least one-sixteenth (1/16) inch of metal will be removed from the die-side thereof. Reaming shall be done with twist drills and without using any lubricant. The outside burrs on reamed holes shall be removed.

Drilled Holes.

149. Holes in steel of greater thickness than ¾ inch shall be drilled from the solid; likewise holes in flanges of rolled beams and channels used in bending, except when situated in the unstressed ends. Outside burrs shall be removed.

Field Connections.

150. All field connections, except those for lateral and sway-bracing, shall be reamed to approved steel template; otherwise the members shall be assembled in the shop and then reamed.

Assembling.

151. The several pieces forming one built member shall be straight; and they shall be firmly drawn together with sufficient bolts, so that the pieces will fit closely. Contact surfaces shall be painted or oiled. The finished member shall be free from twists, bends or open joints.

Web Stiffeners.

152. Web stiffeners shall fit neatly between the flanges of girders. When not otherwise specified, the ends of the stiffeners shall be faced to make true contact bearings with the flange-angles.

Splice-Plates and Fillers.

153. Web splice-plates and fillers under stiffeners shall be cut to fit within ¼ inch of the flange-angles.

Floorbeams and Stringers.

154. Connection-angles for floorbeams and stringers shall be set truly square and to the exact lengths called for on the drawings. The main sections of floorbeams and stringers shall be milled to exact length, after the flanges have been rivetted, and the connection-angles shall be set flush with and true to the milled ends; or the connection-angles may first be rivetted to the girder or beam, and the entire end surfaces milled. The minimum thickness of the connection-angles, after milling, shall be ½ inch.

Size of Rivets.

155. The size of rivets, called for on the plans, shall be understood to mean their actual size before heating.

Rivetting.

156. Rivets shall be uniformly heated to a light cherry red heat; and they shall be driven by pressure tools wherever possible. Pneumatic hammers shall be used for field rivetting in preference to other hand tools.

Rivet Finish.

157. Rivets shall look neat and finished, with heads of approved shape, full and of equal size. They shall be central on the shank, and shall grip the assembled pieces firmly. Recupping and caulking will not be allowed. Loose, burnt or otherwise defective rivets shall be cut out and replaced. In cutting out rivets, great care shall be taken not to injure the adjacent metal; if necessary, they shall be drilled out.

Turned-Bolts.

158. Wherever bolts are used in place of rivets which transmit shear, the holes shall be reamed parallel, and the turned-bolts shall make a driving fit, with the thread entirely outside of the hole. A washer, not less than ¼ inch thick, shall be used under both head and nut.

Eye-Bars.

159. Eye-bars shall be straight and true to size, and shall be free from twists, folds in the neck or head, or any other defect. Heads shall be made by upsetting, rolling or forging. Welding will not be allowed. The form of the heads may be determined by the dies in use at the works where the eye-bars are to be made, if satisfactory to the purchaser's engineer; but the manufacturer shall guarantee the bars to break in the body when tested to rupture. The thickness of head and neck shall not vary more than 1/16 inch from that specified.

Boring Eye-Bars.

160. Before boring, each eye-bar shall be properly annealed and carefully straightened. Pin-holes shall be on the centre-line of the eye-bar and in the centre of the heads. Bars of the same length shall be bored so accurately that, when placed together, pins 1/32 inch smaller in diameter than the pin-holes can be passed through the holes at both ends of the bars, at the same time and without forcing.

Pin-Holes.

161. Pin-holes shall be bored true to gauge, smooth and straight; at right-angles to the axis of the member, and parallel to each other, unless otherwise called for. The boring shall be done after the member has been rivetted up.

162. The distance centre to centre of pin-holes shall be correct within 1/32 inch; the diameter of the holes shall not be more than 1/50 inch larger than that of the pin, for pins up to 5 inches in diameter; and 1/32 inch, for larger pins.

Pilot-Nuts.

163. Pilot and driving nuts shall be furnished for each size of pin.

Pins and Rollers.

164. Pins and rollers shall be accurately turned to gauge; they shall be straight and smooth and entirely free from flaws.

Screw-Threads.

165. Screw-threads shall make a tight fit in the nuts; when over 1⅜ inches in diameter, they shall be made with six threads per inch.

Bed-Plates.

166. Expansion bed-plates shall be planed true and smooth. Cast bed-plates shall be planed top and bottom. The finishing-cut of the planing tool shall be fine, and shall be parallel to the direction of the expansion.

Annealing.

167. Excepting minor details, steel which has been partially heated shall be properly annealed.

Castings.

168. Castings shall be free from large or injurious blow-holes; and steel castings shall be annealed.

Welds.

169. Welds in steel will not be allowed.

MATERIALS.

Steel.

170. Steel shall be made by the open-hearth process.

Properties.

171. The chemical and physical properties of steel shall conform to the following limits:—

Elements Considered	Structural Steel	Rivet Steel	Forged Steel	Steel Castings
Phosphorus, max. (basic)....	0.04%	0.04%	0.04%	0.05%
Phosphorus, max. (acid).....	0.06%	0.04%	0.06%	0.08%
Sulphur, max..............	0.05%	0.04%	0.05%	0.05%

Utimate Tensile Strength, lbs. per square-inch:
- Structural Steel....................60,000, desired;
- Rivet Steel.........................50,000, desired;
- Forged Steel.......................80,000, desired;
- Steel Castings....................65,000, minimum.

Elongation, minimum percentage in 8 inches, Fig. 1:

Structural Steel, Rivet Steel, Forged Steel } $\dfrac{1{,}500{,}000}{\text{Ultimate Tensile Strength}}$

Elongation, minimum percentage in 2 inches, Fig. 2:
- Structural Steel........................22;
- Forged Steel............................20;
- Steel Castings.........................15.

Character of Fracture:
- Structural Steel, Rivet Steel, Forged Steel } silky;
- Steel Castings. . .silky or fine granular.

Cold Bends without Fracture:
- Structural Steel, Rivet Steel, Forged Steel } 180° flat;
- Steel Castings. . . 90°, $d = 3t$;

in which d = diameter of pin,
t = thickness of specimen.

Yield-Point.

172. The yield-point, as indicated by the drop of beam, shall be recorded in the test reports.

Eye-Bar Specimen Tests.

173. In order that the ultimate strength of full-sized annealed eye-bars shall meet the requirements hereinafter specified, the ultimate strength in test-specimens may be determined by the manufacturer; but all other tests than those for ultimate strength shall conform to the above requirements.

Allowable Variations.

174. If the ultimate strength varies more than 4,000 lbs. from that desired, a retest shall be made on the same gauge, which, to be acceptable, shall be within 5,000 lbs. of the desired ultimate.

Chemical Analysis.

175. Chemical determination of the percentages of carbon, phosphorus, sulphur and manganese shall be made by the manufacturer from a test-ingot taken at the time of pouring of each melt of steel; and a correct copy of such analysis shall be furnished to the engineer or his inspector. Check-analyses shall be made from finished materials, if called for by the purchaser; in which case an excess of 25% above the required limits will be permitted.

Specimens.

176. Plate, shape and bar specimens for tensile and bending tests shall be made by cutting coupons from the finished product, which shall have both faces rolled and both edges milled to the form shewn by Fig. 1; or both edges parallel; or they may be turned to a diameter of ¾ inch for a length of at least 9 inches, with enlarged ends.

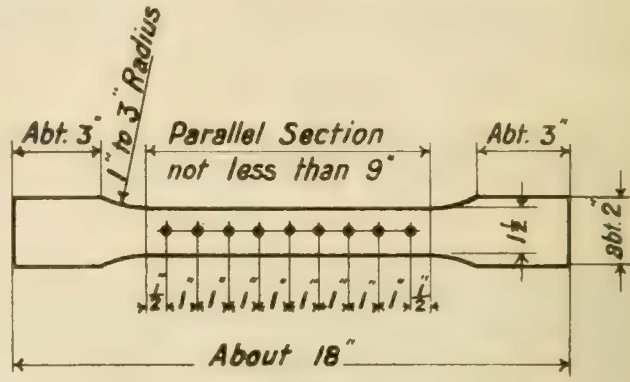


Fig. 1.

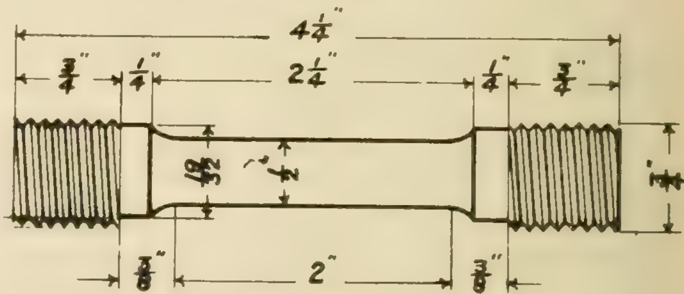


Fig. 2.

Rivet-Rods.

177. Rivet-Rods shall be tested as rolled.

Pin and Roller-Tests.

178. Pin and roller specimens shall be cut from the finished rolled or forged bar, in such manner that the centre of the specimen shall be one inch from the surface of the bar. The specimen for tensile strength shall be turned to the form shewn by Fig. 2. The specimen for bending test shall be one inch by one-half inch in section.

Steel Casting Tests.

179. For steel castings, the number of tests will depend upon the character and importance of the castings. Specimens shall be cut cold from coupons moulded and cast on some portion of one or more castings from each melt; or from sink-heads, if the latter are of sufficient size. The coupon or sink-head so used shall be annealed with the casting before it is cut off. Test-specimens shall be of the form prescribed for pins and rollers.

Specimens of Rolled Steel.

180. Rolled steel shall be tested in the condition in which it comes from the rolls.

Number of Tests.

181. At least one tensile and one bending test shall be made from each melt of steel as rolled. In case steel differing ⅜ inch and more in thickness is rolled from one melt, a test shall be made from the thickest and thinnest material rolled.

Modification in Elongation.

182. A deduction of one per cent. (1%) will be allowed from the specified percentage for elongation, for each ⅛ inch in thickness above ¾ inch.

Bending-Tests.

183. Bending-tests may be made by pressure or by blows. Plates, shapes and bars less than one inch thick shall bend as called for in table of properties, above. Specimen-tests 2½ inches wide of full-sized material for eye-bars, and other steel one inch thick and over, tested as rolled, shall bend cold 180° around a pin, the diameter of which is equal to twice the thickness of the bar, without fracture on the outside of bend.

Bending Angles.

184. Angles of all thicknesses shall open cold to an included angle of 150°, and close to an angle of 30°, without sign of fracture.

Nicked Bends.

185. Rivet steel, when nicked and bent around a bar of the same diameter as that of the rivet rod, shall give a gradual break and a fine silky uniform fracture.

Finish.

186. Finished material shall be free from injurious seams, flaws, cracks, defective edges or other defects; and shall have a smooth, uniform and workmanlike finish. Plates, 36 inches in width and under, shall have rolled edges.

Melt-Numbers.

187. Every finished piece of steel shall have the melt-number and the name of the manufacturer stamped or rolled upon it. Steel for pins and rollers shall be stamped on the end. Rivet and lattice steel and other small parts may be bundled with the above marks on an attached metal tag.

Defective Material.

188. Material which, subsequent to the above tests at the mills and its acceptance there, develops weak spots, brittleness, cracks or other imperfections, or is found to have injurious defects, will be rejected at the shop, and shall be replaced by the manufacturer at his own cost.

Variation in Weight.

189. A variation in cross-section or weight of each piece of steel of more than 2½% from that specified shall be sufficient cause for rejection; except in the case of sheared plates, which shall be covered by the following permissible variations, which apply to single plates, when ordered to weight:—

Plates, 12½lbs. per square foot or heavier:—

(a) Up to 100 inches wide, 2½% above or below the prescribed weight.

(b) 100 inches wide and over, 5% above or below.

Plates under 12½ lbs. per square foot:—

(a) Up to 75 inches wide, 2½% above or below.

(b) 75 inches wide and up to 100 inches wide, 5% above or 3% below.

(c) 100 inches wide and over, 10% above or 3% below.

190. Plates, when ordered to gauge, will be accepted if they measure not more than 0.01 inch below the ordered thickness.

191. An excess over the nominal weight, corresponding to the dimensions on the order, will be allowed for each plate, if not more than that shewn in the following table, one cubic inch of rolled steel being assumed to weight 0.2833 lb.:—

Thickness Ordered.	Nominal Weights.	Width of Plate: Up to 75 ins.	75 to 100 ins.	100 to 115 ins.	Over 115 ins.
¼ in.	10.20 lbs.	10%	14%	18%	
5/16 in.	12.75 lbs.	8%	12%	16%	
⅜ in.	15.30 lbs.	7%	10%	13%	17%
7/16 in.	17.85 lbs.	6%	8%	10%	13%
½ in.	20.40 lbs.	5%	7%	9%	12%
9/16 in.	22.95 lb.s	4½%	6½%	8½%	11%
⅝ in.	25.50 lbs.	4%	6%	8%	10%
Over ⅝ in.		3½%	5%	6½%	9%

Cast-Iron.

192. Except where chilled iron is specified, castings shall be made of tough grey iron, with sulphur not over 0.10 per cent. They shall be true to pattern out of wind and free from flaws and excessive shrinkage. If tests are demanded, they shall be made on the "Arbitration Bar" of the American Society for Testing Materials, which is a round bar 1¼ inches in diameter and 15 inches long. The transverse test shall be made on a supported length with load at middle. The minimum breaking-load so applied shall be 2,900 lbs., with a deflection of at least 1/10 inch before rupture.

Wrought-Iron.

193. Wrought-iron shall be double-rolled, tough, fibrous and uniform in character. It shall be thoroughly welded in rolling, and shall be free from surface defects. When tested in specimens of the form of Fig. I, or in full-sized pieces of the same length, it shall shew an ultimate strength of at least 50,000 lbs. per square inch, an elongation of at least 18 per cent. in 8 inches, with fracture wholly fibrous. Specimens shall bend cold, with the fibre, through 135 degrees, without sign of fracture, around a pin the diameter of which is not over twice the thickness of the piece tested. When nicked and bent, the fracture shall shew at least 90 per cent. fibrous.

Tool-Steel.

194. Tool-steel shall be used generally for parts which require hardening or oil-tempering, such as pivots, friction-rollers, ball-bearings and springs.

195. Tool-steel shall be made by the open-hearth or crucible process; and its chemical properties shall be as follows:—

Carbon	1.00% minimum;
Phosphorus	0.04% maximum;
Sulphur	0.04% maximum;
Manganese	0.50% maximum.

Phosphor-Bronze, for Bushings and Discs.

196. Special phosphor-bronze shall be used for high pressures with low speed. The metal shall have a minimum elastic-limit in compression of 24,000 lbs. per square inch. Test-pieces shall be one-inch cubes, finished; and they shall be cut from coupons, moulded and cast on some portion of each casting. The composition of phosphor-bronze shall be as follows:—

Copper	79.0 to 81.0%
Tin	9.0 to 11.0%
Lead	8.0 to 11.0%
Phosphorus	0.5 to 1.0%
Other Elements	0.0 to 0.5%

Babbitt-Metal.

197. The composition of babbitt-metal shall be as follows:—

No. 1.	Tin	86.0%
	Copper	6.0%
	Antimony	8.0%
No. 2.	Tin	32.0%
	Copper	3.0%
	Antimony	14.0%
	Lead	51.0%
No. 3.	Tin	5.0%
	Antimony	15.0%
	Lead	80.0%

Timber.

198. Timber may be oak, southern long-leaf pine, Douglas-fir, white, red or Norway pine, spruce or birch; and, unless otherwise specified, it shall be of the grade known as *merchantable*.

FULL-SIZED TESTS.

Eye-Bar Tests.

199. When specified by the purchaser's engineer, full-sized tests on eye-bars and similar members, to the extent of at least 2% of the number required, shall be made at the manufacturer's expense. If these tests do not meet the requirements herein specified, all members represented thereby will be rejected.

200. In eye-bar tests, the minimum ultimate strength shall be 55,000 lbs. per square-inch. The elongation in 10 feet, including fracture, shall not be less than 15%. Bars shall generally break in the body, and the fracture shall be silky or fine granular; the elastic-limit, as indicated by the drop of the mercury, shall be recorded. Should a bar break in the head yet develop the specified elongation, utimate strength and character of fracture, it will not be rejected, provided not more than one-third of the total number of bars tested fail in this manner.

INSPECTION AND TESTING AT THE MILLS.

Mill-Orders.

201. The purchaser shall be furnished complete copies of mill-orders; and no material shall be rolled nor work done before the purchaser has been notified where the orders have been placed, so that he may arrange for the inspection.

Facilities for Inspection.

202. The contractor shall furnish all facilities for the inspecting and testing of all material at the mill where it is to be manufactured. He shall furnish a suitable testing-machine for testing the specimens, as well as prepare the pieces for the machine, free of cost.

Access to Mill.

203. When an inspector is furnished by the purchaser to inspect material at the mills, he shall have full access, at all times, to all parts of the mills where material to be inspected by him is being manufactured.

INSPECTION AND TESTING AT THE SHOPS.

Facilities for Inspection.

204. The contractor shall furnish all facilities for inspecting and testing the quality of workmanship at the shop where the material is to be fabricated.

Starting Work.

205. The purchaser shall be notified well in advance of the start of the work in the shop, in order that he may have an inspector on hand to inspect material and workmanship.

Access to Shops.

206. When an inspector is furnished by the purchaser, he shall have full access, at all times, to all parts of the shop where material under his inspection is being fabricated.

Accepting Materials.

207. The inspector shall stamp each piece accepted with a private mark. Any piece not so marked may be rejected at any time and at any stage of the work. If the inspector, through an oversight or otherwise, has accepted material or work which is defective or contrary to the specification, such material or work, no matter in what stage of manufacture, may be rejected by the purchaser.

Shop-Plans.

208. The purchaser shall be furnished complete shop-plans.

Shipping-Invoices.

209. Complete copies of shipping-invoices shall be furnished to the purchaser with each shipment. These shall shew the scale-weights of individual pieces.

PAINTING, CREOSOTING AND ASPHALT.

Metal Cleaned.

210. Before painting, all metal surfaces shall be thoroughly scraped and cleaned of rust, scales or dust, either with the sand-blast, steel scrapers or stiff wire brushes; finally, the surfaces shall be dusted off with a stiff bristle brush.

Shop-Coat of Paint.

211. Unless otherwise required by the purchaser's engineer, the paint for shop priming-coat shall be pure red-lead and lampblack, mixed with pure boiled linseed oil in the following proportions: red-lead, 25 lbs.; lampblack, 4 oz.; boiled linseed oil, one gal. It shall not be thinned with turpentine, benzine or other liquids, and no drier will be allowed. The red-lead and lampblack shall be mixed dry, the oil added, and the mixture stirred to an uniform consistency and applied at once. Only a sufficient quantity for immediate use shall be mixed at one time.

Inaccessible Surfaces.

212. All surfaces inaccessible after erection, including top surfaces of stringers, eye-bar heads, ends of posts, chords, etc., shall have two coats of paint in the shop. All planed and turned surfaces shall be cleaned and coated with white-lead, mixed with tallow, before leaving the shop.

Metal Cleaned after Erection.

213. After the erection of the structure, all rust spots shall be thoroughly cleaned; and, where the paint has been rubbed off, it shall be repainted. All rivet-heads, bolt-heads and nuts, which have been placed in the field, shall be given a coat of the shop-paint before the field-coats are applied.

Field-Coats of Paint.

214. The structure shall be given two field-coats of approved paint after erection. These coats shall preferably be of different colours, in order that they may be readily distinguished.

Wet Weather.

215. No painting will be allowed in wet or freezing weather. Painting shall be done by skilled workmen.

Creosoting.

216. Timber to be creosoted shall be thoroughly seasoned, at a temperature not exceeding two hundred and thirty (230) degrees, Fahrenheit, in a vacuum of twenty-four (24) inches of mercury; and not less than ten (10) lbs. of heavy creosote oil to each cubic foot of timber shall be forced into the timber, under a pressure of not less than one-hundred and fifty (150) lbs. per square inch.

Creosote Oil.

217. Creosote oil shall contain not less than five (5) per cent. of otar acids, and not less than twenty-five (25) per cent. of ingredients that do not distill over a temperature of six hundred (600) degrees, Fahrenheit. It shall, generally, be solid at a temperature of fifty (50) degrees, Fahrenheit, and entirely liquid at a temperature of one hundred (100) degrees, Fahrenheit. It shall be free from water, ammonia, naphtha and any other impurities.

Quality of Asphalt.

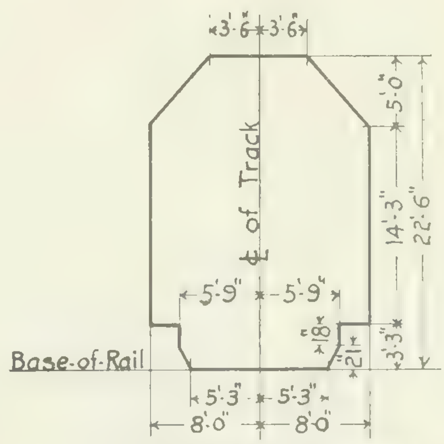
218. Asphalt shall be of the best quality, free from coal-tar and its products; it shall not volatilise more than one-half (½) of one per cent. under a temperature of three hundred (300) degrees, Fahrenheit, for ten (10) hours.

219. For under-ground structures, a flow-point of one hundred and eighty-five (185) degrees, Fahrenheit, and a brittle-point of six (6) degrees, Fahrenheit, below zero, will be required.

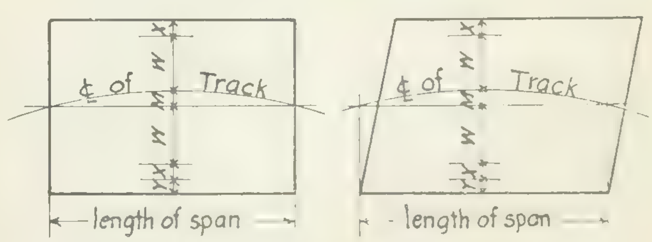
COMMITTEE

P. B. Motley, *Chairman*	J. G. Legrand
H. B. Stuart	Geo. W. Craig.
H. P. Borden	F. D. Cole
F. P. Shearwood	E. G. W. Montgomery
G. H. Duggan	H. A. Icke
A. E. Johnson	M. A. Lyons
W. Chase Thomson, *Secretary*	A. H. Harkness
W. A. Bowden	C. N. Monsarrat, *Lt.-Col.*

APPENDIX I: CLEARANCE DIAGRAMS

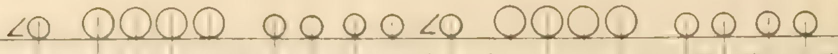


For Bridges on Tangents



Additional Lateral Clearances
For Bridges on Curves

APPENDIX II: LIVE-LOAD DIAGRAM



Train Load

8' 5' 5' 5' 9' 5' 6' 5' 8' 8' 5' 5' 5' 9' 5' 6' 5' 5'

Class E30	15000	30000	30000	30000	30000	19500	19500	19500	19500	15000	30000	30000	30000	30000	19500	19500	19500	19500	3000 lbs. per lineal-foot
Class E35	17500	35000	35000	35000	35000	22750	22750	22750	22750	17500	35000	35000	35000	35000	22750	22750	22750	22750	3500 lbs. per lineal-foot
Class E40	20000	40000	40000	40000	40000	26000	26000	26000	26000	20000	40000	40000	40000	40000	26000	26000	26000	26000	4000 lbs. per lineal-foot
Class E45	22500	45000	45000	45000	45000	29250	29250	29250	29250	22500	45000	45000	45000	45000	29250	29250	29250	29250	4500 lbs. per lineal-foot
Class E50	25000	50000	50000	50000	50000	32500	32500	32500	32500	25000	50000	50000	50000	50000	32500	32500	32500	32500	5000 lbs. per lineal-foot
Class E55	27500	55000	55000	55000	50000	35750	35750	35750	35750	27500	55000	55000	55000	55000	35750	35750	35750	35750	5500 lbs. per lineal-foot
Class E60	30000	60000	60000	60000	60000	39000	39000	39000	39000	30000	60000	60000	60000	60000	39000	39000	39000	39000	6000 lbs. per lineal-foot

Note: All loads are given in pounds, and for one track.

APPENDIX III.

MAXIMUM MOMENTS, SHEARS AND FLOOR BEAM REACTIONS

Class E 40. 2 Rails

L Span feet	M Max. Mom. ft. lbs.	S Max. End Shear lbs.	R Max. Floor Beam Reac. lbs.	L Span feet	M Max. Mom. ft. lbs.	S Max. End Shear lbs.
10	112,480	60,000	80,000	46	1,659,040	165,600
11	131,400	65,520	87,280	48	1,776,000	169,600
12	160,000	70,000	93,280	50	1,902,000	174,240
13	190,000	73,800	98,480	52	2,030,000	178,480
14	220,000	77,200	104,320	54	2,162,000	182,400
15	250,000	80,000	109,280	56	2,304,000	186,000
16	280,000	85,040	113,680	58	2,446,000	190,800
17	310,000	89,520	117,600	60	2,599,200	195,200
18	340,000	93,440	121,280	62	2,752,960	200,240
19	373,200	96,800	125,840	64	2,911,040	205,200
20	412,480	100,000	131,120	66	3,079,040	210,000
21	452,000	102,800	136,000	68	3,247,040	215,600
22	491,400	105,520	140,320	70	3,415,040	221,040
23	530,800	107,920	144,320	72	3,584,000	226,720
24	570,400	110,800	148,000	74	3,758,000	232,640
25	610,000	113,600	151,280	76	3,942,000	238,080
26	649,600	116,080	155,440	78	4,129,000	243,440
27	689,200	118,480	160,080	80	4,321,000	248,400
28	731,000	120,800	164,720	82	4,513,040	253,840
29	775,800	123,120	168,720	84	4,713,040	259,040
30	821,040	126,080	172,480	86	4,919,040	264,240
31	865,680	128,800	176,880	88	5,128,000	269,440
32	910,800	131,520	182,000	90	5,341,040	274,480
33	955,600	133,920	186,720	92	5,552,000	279,600
34	1,000,720	136,080	191,120	94	5,771,000	284,720
35	1,046,000	138,400	. .	96	5,988,000	289,600
36	1,097,000	141,120	. .	98	6,213,000	295,040
37	1,148,480	143,840	. .	100	6,440,000	300,000
38	1,200,000	146,240	. .	105	7,075,040	312,240
39	1,253,520	148,640	. .	110	7,774,000	324,000
40	1,311,040	150,800	. . . .	115	8,490,000	335,840
42	1,427,040	156,240	. .	120	9,220,000	347,440
44	1,543,200	161,120	. . .	125	9,993,040	358,800

APPENDIX IV.

SHEARING AND BEARING VALUES OF SHOP RIVETS

Diam of Rivet	Single Shear at 11,000 lb. per sq. in.	Bearing Value for different thicknesses of Plate at 22,000 lbs. per square inch.												
		1/4″	5/16″	3/8″	7/16″	1/2″	9/16″	5/8″	11/16″	3/4″	13/16″	7/8″	15/16″	1″
3/8″	1,210	2,060	2,580	3,090										
1/2″	2,160	2,750	3,440	4,130	4,820	5,500								
5/8″	3,370	3,440	4,300	5,160	6,020	6,880	7,740	8,600						
3/4″	4,860	4,130	5,160	6,190	7,220	8,250	9,280	10,320	11,340	12,380				
7/8″	6,610	4,810	6,020	7,220	8,430	9,630	10,840	12,040	13,240	14,440	15,640	16,840	18,050	
1″	8,640	5,500	6,880	8,250	9,630	11,000	12,380	13,750	15,130	16,500	17,880	19,250	20,630	22,000

SHEARING AND BEARING VALUES OF FIELD RIVETS

Diam. of Rivet	Single Shear at 10,000 lb. per sq. in.	Bearing Value for different thicknesses of Plate at 20,000 per lbs. square inch.												
		1/4″	5/16″	3/8″	7/16″	1/2″	9/16″	5/8″	11/16″	3/4″	13/16″	7/8″	15/16″	1″
3/8″	1,100	1,880	2,340	2,810										
1/2″	1,960	2,500	3,130	3,750	4,380	5,000								
5/8″	3,070	3,130	3,910	4,690	5,470	6,250	7,030	7,810						
3/4″	4,420	3,750	4,690	5,630	6,560	7,500	8,440	9,380	10,310	11,250				
7/8″	6,010	4,380	5,470	6,570	7,660	8,750	9,840	10,940	12,030	13,130	14,220	15,310	16,410	
1″	7,850	5,000	6,250	7,500	8,750	10,000	11,250	12,500	13,750	15,000	16,250	12,750	18,750	20,000

All bearing values or to right of upper zig-zag lines are greater than double shear. Values between upper and lower zig-zag lines are less than double and greater than single shear.

Values below and to left of lower zig-zag lines are less than single shear.

For hand driven rivets and turned bolts reduce above values for field rivets by 20%.

APPENDIX V.

Data to be Supplied by the Purchaser's Engineer

1. Location of proposed bridge and general description of site.
2. Plan and profile of bridge-site, giving elevation of base-of-rail and of high and low water, speed of current and character of bottom.
3. Diagrams of abutments and piers (if built), shewing their location and giving elevations and dimensions of bridge-seats.
4. Number and spacing of tracks.
5. Superelevation of outer rail for bridge on curved track.
6. Type of floor.
7. In the case of timber floors, whether the rails are to be laid by the purchaser or by the contractor; whether the purchaser will provide and lay the ties, or only provide the ties (either framed or unframed) for the contractor to lay; or whether the ties shall be provided, framed and laid by the contractor.
8. Class of live-load.
9. Whether the field-painting is to be done by the purchaser or by the contractor; if the field-coats of paint are to be provided and applied by the contractor, the kind of paint to be used.
10. Whether full-sized tests will be required for eye-bars.
11. Type of movable bridge (if any).
12. Whether a movable bridge is to be operated by electric-motor, steam-engine, gasoline-engine, or by hand-power only.
13. Time for opening a movable bridge.
14. Clear width of waterway and clear height above water when a movable bridge is open.
15. Angle of rotation for a swing-bridge.
16. Whether rail-locks and interlocking signals are to be provided for a movable bridge.
17. In case the proposed bridge is to replace an existing structure, the purchaser's engineer should provide an outline sketch of the latter, with sufficient details to enable tenderers to figure on the operation of taking it down; he should state whether any changes are to be made in the existing bridge-seats, giving plans of old and new masonry; he should give the working-time between trains for the ordinary operations of erection; also the special time that could be given for moving out an old span and replacing it by a new one. Furthermore, he should state whether the old structure is to be taken down and placed on cars, or such other disposition of same as may be contemplated.
18. In all cases, the purchaser's engineer should state what traffic facilities will be given on the railway which he represents: whether free haulage for materials entering into the structure or for the contractor's tools and equipment will be given, or free transportation for his men, otherwise, the rates to be charged for same; what engine-service the railway will supply, and the cost thereof; also, whether the railway will supply, free of charge, signal-guards for the track, or, if charged for, at what rate.

Heat Transfer Tests of Building Materials

By L. M. Arkley, M.E.I.C., Toronto Branch.
Asst. Professor of Mechanical Engineering, University of Toronto.

In 1912 the following series of tests were started at the request of the Department of the Provincial Secretary of the Ontario Government for the purpose of assisting in the selection of the proper materials to be used in buildings in course of erection at that time by the Department. The general method of making the tests was decided at a conference including Professor Angus of the University of Toronto, Capt. R. J. Durley, M.E.I.C., consulting engineer to the Ontario Government, James Govan, Architect of the Department of the Provincial Government and the writer.

In 1913 another set of tests was authorized to determine the effect on the transfer of heat through a 12″ hollow tile wall of laying it up, first with the hollow spaces horizontal, and second with the hollow spaces vertical and directly over each other.

And in 1914 a third set of tests was required to investigate the heat insulating qualities of a number of materials which might be used in the walls of refrigerating rooms.

The apparatus shown in figures one and three was installed in the Thermodynamic Laboratory of the University of Toronto in order to carry out these tests.

Object of Tests made in 1912.

To compare the insulating values of walls of approximately equal thickness but built of different materials, viz.:

8″ hollow concrete block

9″ brick wall

7¾″ hollow tile

and further to determine the effect in insulating value of plastering the walls and of stopping air circulation in the hollow walls by filling the spaces with cheap materials, or by using paper on the inside of the walls.

The most common methods that have been employed in making such tests are as follows:

(1) A box is made of the material to be tested, inside this box is placed a vessel containing a weighed quantity of hot water at a known temperature, (the water must be agitated in order to get the true average) by taking the temperature after a certain time the b.t.u. loss may be approximately computed.

(2) The same arrangement as in method No. 1 is employed but a weighed quantity of ice is used instead of the hot water, and the b.t.u's transmitted computed from the weight of ice melted in a certain time.

(3) An electric heater made of fine resistance wire wound on an electrically insulated sheet is embedded in the material to be tested and the b.t.u's computed from the electrical energy supplied to the heater in a given time.

(4) A box is built of the material to be tested and the heat is supplied to the inside of this box by means of an electric heater. This box is placed in a room which is kept at a low temperature by means of a refrigerating machine. By measuring the current and temperature inside and outside the box the b.t.u. loss may be computed.

The main objection to the first three methods mentioned is that they do not represent conditions found in practice and from the nature of methods No. 1 and No. 2 it is almost impossible to get accurate results.

In most cases in practice either in dealing with heating problems or problems in refrigeration the medium of transfer of heat is air, and air usually in motion, so that in choosing a method for making these tests a modification of method No. 4 was decided upon, but instead of using a box it was decided to use a wall whose exact area could be measured directly. See Sketch No. 1.

Arrangement of Wall and Instruments in Making Tests.

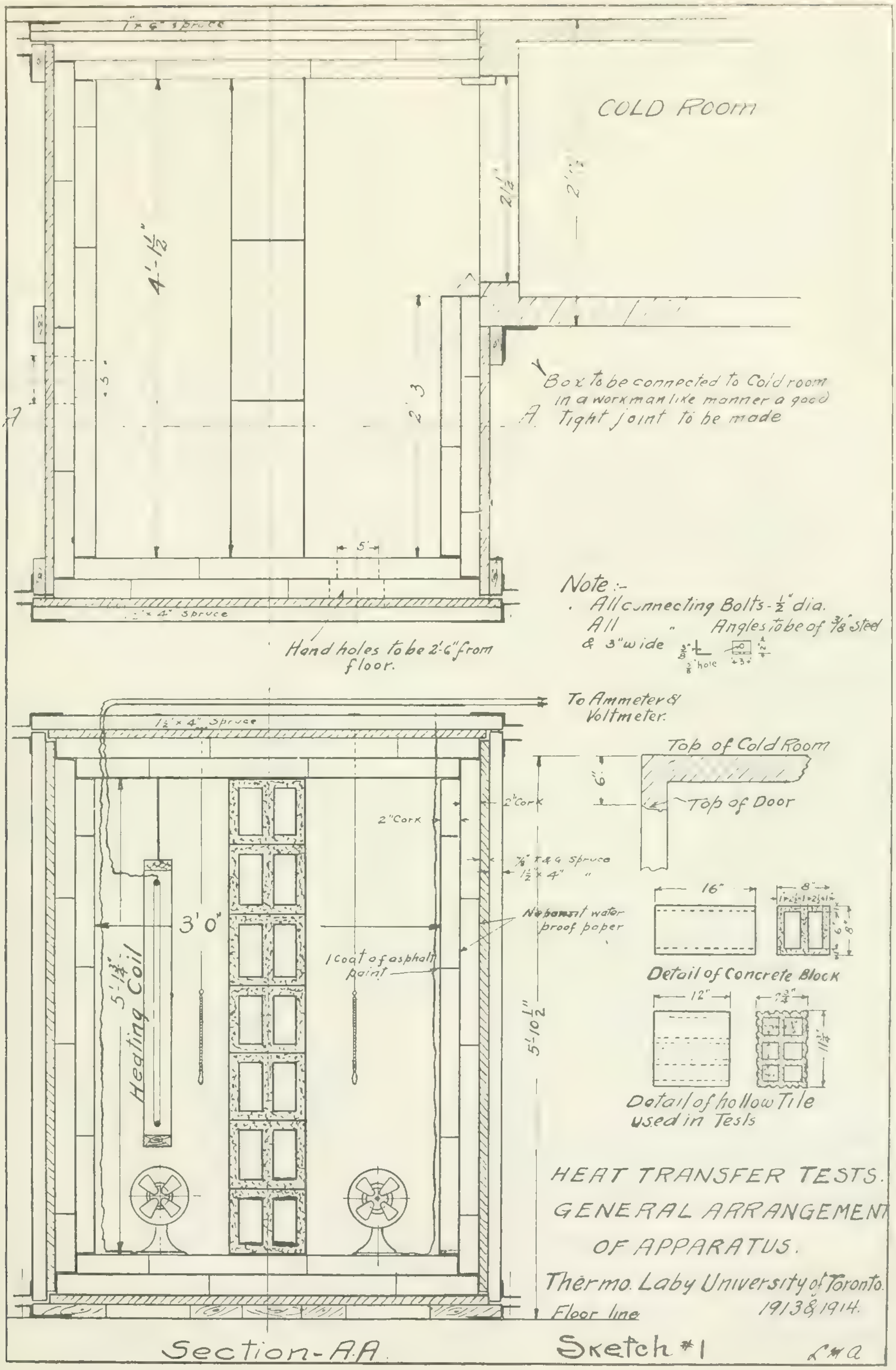
By referring to sketch No. 1 the arrangement of the testing apparatus will be seen. A box was made of ⅞″ T. and G. sheeting supported by 2″ x 4″ scantling and held together by steel angle braces and bolts. This box was lined with two 2″ layers of pressed cork held together by wooden pegs, all joints were carefully broken and a sheet of water proof paper was placed between the layers of cork, the inside of the box was finished with a coat of asphalt paint.

Into this box, which is a very good heat insulator, the wall or material to be tested was built in such a manner as to divide the box into two compartments. When the wall to be tested was in place the cover ends and sides of the box were firmly drawn together by means of bolts. One of these compartments communicated direct with the cold room of a 3-ton refrigerating machine and in this way a temperature of 20°F., or lower if desired, was easily maintained. While on the opposite side of the wall heat was supplied by means of an electric heater made of resistance wire strung on a 3′ x 3′ frame, a bank of lamps and a rheostat placed in the circuit supplying the heater allowed any desired quantity of heat to be supplied.

To get the average temperature on each side of the wall four thermometers were suspended from the roof of the box two on the cold side and two on the hot. When readings were required these thermometers were partially withdrawn through small openings in the covers, but the bulb of the thermometer was never exposed to the room temperature. These thermometers indicated the necessity of circulating the air on each side of the wall in order to get a uniform temperature, and two small electric fans were placed one on each side of the wall inside the box to give the required circulation. The electric current being supplied to the heater and fan was measured by means of an accurately calibrated voltmeter and ammeter.

Method of Conducting Test.

The refrigerating machine and fans were operated until the temperatures on each side of the wall remained constant. This indicated that all the heat being put in to the high temperature side of the box was being transferred


COLD Room
4'-1½"
2'-3
2½"
5"
Box to be connected to Cold room in a workman like manner a good tight joint to be made
Hand holes to be 2'-6" from floor.
Note:-
All connecting Bolts-½" dia.
All " Angles to be of 3/8" steel & 3" wide
To Ammeter & Voltmeter.
1½" x 4" Spruce
Top of Cold Room
Top of Door
6"
2" Cork
7/8" x 4 Spruce
1½" x 4" "
Neponset water proof paper
1 Coat of asphalt paint
3'0"
5'-1¾"
Heating Coil
5'-10½"
16"
8"
Detail of Concrete Block
12"
Detail of hollow Tile used in Tests
HEAT TRANSFER TESTS.
GENERAL ARRANGEMENT OF APPARATUS.
Thermo. Laby University of Toronto.
1913 & 1914.
Floor line
Section-A-A
Sketch #1

through the wall. After this state had been reached a run of about an hour's duration was made while readings of temperature amperes and volts were taken every ten minutes.

Method of Making Calculations.

As an example we will work out the value found in test No. 1 on log. sheet page 7.

1 watt = .0009477 b.t.u's per sec.
1 " = 3.41172 b.t.u's per hr.
Watts = Amperes × volts
" = .647 × 227.7 = 147.32 used by heater
" = .240 × 113.8 = 27.31 " " fan

Total watts used. .174.63

$$\text{B.t.u's per sq. ft. per hr.} = \frac{174.63 \times 3.41172}{19.65 \times 48.1} = 0.63$$

per degree diff. of temperature.

Possible Errors in the above Method.

(1) Leakage of heat from the high temperature side of box to the surrounding air or vice-versa.

From the dimensions of the box it will be seen that the surface exposed to such a loss is about 26 square feet.

A liberal value for the heat loss in b.t.u's per square foot per hour per degree difference of temperature for the the box is .0875.

Assuming a difference of temperature between the room and high temperature side in box of 1½° the heat loss per hour would be

26 × .0875 × 1.5 = b.t.u. per hr. = 3.4

This value is so small as to be negligible for practical purposes.

In order that there might be little loss from this source the temperature of the room was kept as near 70°F. as possible. In most cases the difference between the room temperature and that inside the box on the high temperature side of wall was much less than 1½°. The range of temperature decided on for the tests was from 70°F. on hot side to 20°F. on cold side giving a temperature of 50°F.

(2) Possible error due to length of run.

The accuracy of the method employed in making these tests depends on the length of run being sufficient to allow the heat to permeate the wall and the heat gradiant to be established, this is indicated by the temperature on both sides of the wall becoming constant; until this point is reached it would not be correct to assume that all heat being supplied was passing through the wall.

In testing the hollow walls with spaces vertical a good check on this point was obtained by inserting a thermometer through the box cover into the centre of the wall. When the thermometers on the high and low temperature sides of the wall showed a stationery condition the thermometer in the centre indicated very nearly the mean of the other two readings.

As stated in the beginning of this report, three series of tests were made, in 1912-13 and 1914 and the report is therefore divided into 3 parts: descriptions of the walls tested, specifications for plastering and log sheets of tests follow each part.

Tests made in 1912.

Description of materials used in walls tested.

Concrete Blocks.—For dimensions see sketch No. 1.

Composition. One bag cement to four cubic feet of sand and one cubic foot of ¾" crushed stone with ¼" and all below screened out.

Age—about two months. Weights 38½ lbs. Weight of water absorbed per block after being submerged 24 hours, 3¾ lbs.

Tile.—For dimensions see sketch No. 1.

Dry weight of tile 30¾ lbs. Weight of water absorbed per block after being submerged 24 hours, 3½ lbs.

Brick.—Hard burned common brick, dimensions 2½" x 4¼" x 8½".

Weight dry = 4.67 lbs. Weight of water absorbed per brick after being submerged 24 hours, 1.125 lbs.

Flooring felt used in test No. 6, actual weight per 100 square feet = 11.5 lbs.

Tarred felt used in test No. 7 known as 16 oz. felt, actual weight per 100 square feet = 25 lbs.

Asphalt felt used in test No. 8 known as Neponsit, Asphalt felt.

Specification of the construction and finish of walls to be built at Thermodynamics Building, University of Toronto, for thermal-conductivity tests by James Govan, Architect.

Test No. 1—Tile Wall.

Tiles to be used.—Wall to be built of 8" x 8" x 16" concrete hollow wall tiles.

Mortar.—Mortar for building tile to be composed one part lime to three parts of good clean sharp sand.

Joints.—Joints to be ⅜" wide.
Tiles to be wetted before laying to prevent absorption of water from mortar.

Furring strips.—Provide and build into side of wall away from refrigerator at every second joint, wood furring strips ⅜" x 1¼" for wood strapping.

Strapping.—Strap this side of wall with wood straps at 12" centres.

Metal lath.—Metal lath for plastering to be expanded metal No. 24 gauge.

Plastering.—Plastering on this side of wall to be three coat work composed as follows:—

1st coat.—One part alca and lime mixture as supplied
Three parts sand.
Fibering material or hair as required.
This coat to be thoroughly scratched.

2nd coat.—One part alca and lime mixture
Four parts sand.
Fibering material as required.

Finishing coat.—One part alca and lime mixture
One part fine white sand, trowelled to a smooth polished surface.

Stucco on side of wall next refrigerator.—Base coat shall be applied direct to the tile wall and shall consist of one part alca and plaster mixture to four parts sand. Surface of tile wall must be thoroughly wetted before this base coat is applied and the mortar scratched in preparation for the second coat.

LOG OF RESULTS TESTS MADE IN 1912

Date	No. of test	CONDITIONS	Average Temperature Room	High side	Low side	Total watts	No. of sq. ft. of wall surface	B.T.U's transferred per 1 degree diff. of temper. hr. per sq. ft.
			F	F	F			
1912 Dec. 23	1	Hollow concrete block wall. Not plastered. Air spaces empty	67.9	68.1	20°	174.63	19.65	0.630
Dec. 28	2	Hollow concrete block wall. Not plastered. Air space filled with sawdust	70.7	72	22	126.21	19.65	0.438
1913 Jan. 8	3	Hollow concrete block wall. Plastered both sides. Air space filled with sawdust	72.43	73.5	22.75	99.83	19.65	0.342
Jan. 9	4	Hollow concrete block wall. Plastered both sides. Air spaces empty	74.5	76	23.75	152.76	19.65	0.506
Jan. 13	5	Hollow concrete block wall. Plastered both sides. Air spaces filled with gravel.	71.75	71.15	21.90	109.52	19.65	0.385
Jan. 18	6	Hollow concrete block wall. Plastered both sides. Air spaces empty. One layer of flooring felt on high temperature side of wall	72.1	73.45	22.75	75.70	19.34	0.263
Jan. 21	7	Hollow concrete block wall. Plastered both sides. Air spaces empty. One layer of tarred bldg. paper on high temp. side of wall	74	74.75	22.82	75.92	19.34	0.258
Jan. 22	8	Hollow concrete block wall. Plastered both sides. Air spaces empty. One layer of asphalt paper on high temp. side	74	73	23	74.46	19.34	0.263
Feb. 4	9	Brick wall without plaster, 9″	73	72.45	22.5	118.92	20.56	0.392
Feb. 6	10	Brick wall without plaster, 9″	69	72.25	21.6	121.04	20.56	0.397
Feb. 17	11	Hollow tile without plaster. Air spaces empty	68.8	69.16	20.33	119.43	20.05	0.416
Feb. 19	12	Hollow tile without plaster. Air spaces filled with gravel	71.3	71.82	22.75	102.32	20.05	0.355

Second coat to be composed of one part alca and plaster mixture, to four and one-half parts sand, trowelled smooth.

This second coat must be applied before the first coat is allowed to dry out.

Test No. 2—Brick wall.

Bricks.—Bricks to be good, common stock bricks, approved of by the architect.

Mortar.—Mortar for building bricks to be composed of 1 part lime to 3 parts clean sharp sand.

Joints to be ⅜″ thick and struck on both sides of wall. Bricks to be thoroughly wetted before laying.

No plastering inside or outside of brick wall.—NOTE: There will be no plastering on either inside or outside of brick wall for this test.

Conclusions

The most important conclusion to be drawn from the above results is that the commonly held assumption that a hollow block wall is more efficient from a heat loss standpoint than a solid brick wall of approximately equal commercial standard thickness is not founded on fact, this will be clearly seen by comparing tests Nos. 1, 9, 10, and 11. On the other hand tests Nos. 2, 3, 5 and 12 show that if the spaces in the hollow block wall are filled with some material which separates the air into small pockets and prevents circulation that the rate of transfer of heat is considerably diminished.

An interesting result is shown by comparing test No. 4 with No. 7 the conditions in these tests are exactly the same with the exception that one layer of tarred building paper was placed on the high temperature side of the wall in test No. 7, the effect of this layer of paper was to reduce the heat transfer by nearly 50%.

Tests Nos 9 and 10 serve as a check on the work as many tests have been made on 9″ brick walls and the commonly accepted value as the coefficient of conductivity is 0.4 b.t.u.

It may be mentioned that in having the brick wall built, the architect took special pains to see that the laying of the bricks was no better than the ordinary standard of bricklayers practice, no attempt was made to have all points in the interior of the wall filled and the face jointing was struck with the trowel as the wall was laid up. If the bricklayer had been allowed to fill carefully every joint with mortar and to have the wall so well flushed as to reduce air circulation through the wall to a minimum, better results would no doubt have been obtained. On the other hand in building the 7¾″ hollow tile wall the practice adopted was decidedly better than would obtain in ordinary contract work.

Where hollow tile are laid with webs vertical it is practically impossible to get the bricklayers to spread mortar on all webs of the tile, as a rule the two outside and the two end webs receive mortar while the interior webs are left uncovered, In the wall tested every web was carefully covered and every precaution taken to keep the air spaces free.

When the wall was built the outside and inside face joints were carefully pointed up so as to reduce air circulation through the joints to a minimum. Under these conditions the results obtained are probably more favorable to the hollow tile wall than they would be in ordinary construction practice.

NOTE: Saw dust was not used as filling with the idea that it would be a suitable material for building construction but simply to show the effect of breaking up the circulation of the air in a hollow block wall.

Tests made in 1913.

Object of Tests.—(a) To determine the rate of transfer of heat through a 12″ hollow tile wall, first when the tile was laid with the hollow spaces horizontal; second when the tile was laid with the hollow spaces vertical and directly over each other.

(b) To determine the effect on the rate of transfer of heat of placing a layer of ordinary building paper on the high temperature side of wall.

(c) To determine the effect on the rate of transfer of heat of painting the high temperature side of the wall with one coat of "dehydratine".

Materials used in Walls.

Tile.—The hollow tile used was a shale tile made at the Ontario Government's clay plant at Mimico, Ont. for dimensions—see sketch No. 1.

"Dehydratine".—Described by the manufacturers as a "Foundation compound for waterproofing substructures."

It has about the consistency of the ordinary ready mixed paint, is black in color and is made up principally of asphalt.

These tests were made in the same manner as those previously described in this report and the specifications for plastering are the same for both series of tests.

Conclusions.

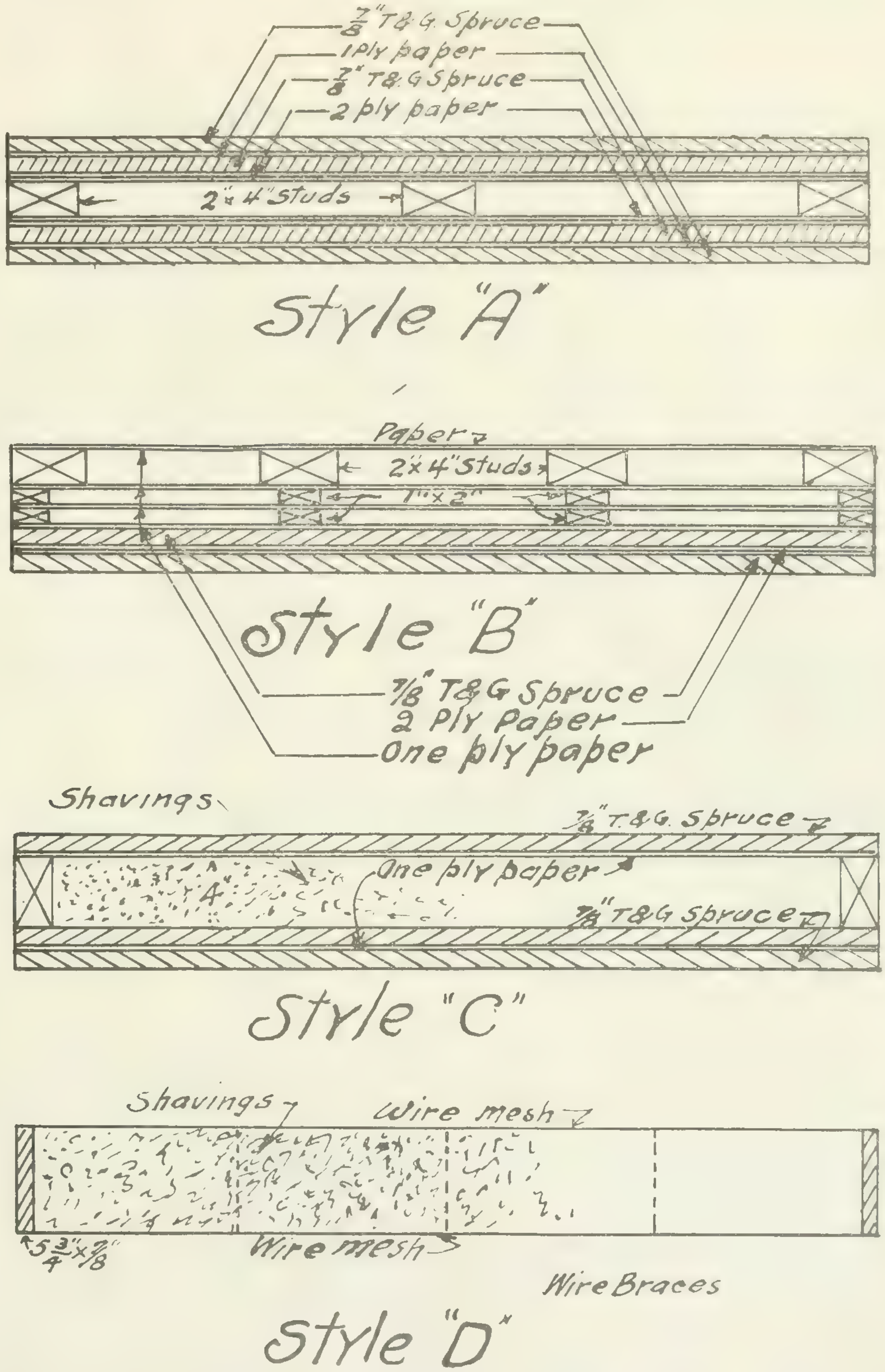
Comparing tests No. 1 and No. 2 the marked improvement in the insulating qualities of a layer of paper is again demonstrated.

From test No. 3 it would appear that one coat of "dehydratine" accomplishes practically the same result as a layer of paper, this is what might be expected as both the paper and "dehydratine" serve to close the pores in the wall.

Comparing test No. 1 with No. 6, we see that the wall is a better heat insulator when the hollow spaces in the tile run horizontally than they when are vertical. In the second case the circulation of air would be much more pronounced due to the chimney effect of the vertical hollow spaces.

Comparing tests Nos. 1 and 3 with Nos. 6 and 7, approximately the same saving is shown due to one coat of "dehydratine".

Comparison of the results obtained with walls plastered and without plaster show that plaster is not a good heat insulator.


7/8" T&G Spruce
1 ply paper
7/8" T&G Spruce
2 ply paper
2"x4" Studs
Style "A"
Paper
2"x4" Studs
1"x2"
Style "B"
7/8" T&G Spruce
2 Ply Paper
One ply paper
Shavings
7/8" T.&G. Spruce
One ply paper
4
7/8" T&G Spruce
Style "C"
Shavings
Wire mesh
5 3/4"x 7/8
Wire mesh
Wire Braces
Style "D"

Sketch #2

LOG SHEET OF RESULTS TESTS MADE IN 1913

Date	No. of test	CONDITIONS	Average Temperature			Total watts	Sq. ft. of wall surface	B.T.U's transfer per degree diff. of temper. hr. per sq. ft.
			Room	High side	Low side			
1913 Dec. 16	1	12″ tile wall laid with hollow spaces horizontal	70.7	71.75	20.9	91.78	20.91	.295
Dec. 17	2	12″ tile wall as above but with 1 layer of paper on high temp. side of wall	70.6	69.55	19.	6.5	20.91	.210
Dec. 18	3	12″ tile wall as above with paper removed and 1 coat of dehydratine painted on high temp. side of wall	70.	70.13	19.9	63.75	20.91	.206
Dec. 25	4	12″ wall as above but plastered both sides, plaster 5/8″ thick	65	67	18.25	53.75	20.91	.179
Feb. 27	5	New 12″ tile wall built with hollow spaces vertical and directly over each other	72	70	20.4	99.7	21.28	.322
Mar. 2	6	12″ wall as above with one coat of dehydratine on high temp. side	69.5	69.25	20.45	76.4	21.28	.250
Mar. 9	7	12″ wall as above but plastered both sides, plaster 5/8″ thick	73.3	70	20.8	69.97	21.28	.228

Tests made in 1914.

Object of Tests.—To determine the rate of transfer of heat through walls suitable for refrigerating rooms including built up walls, (for details see sketch No. 2), cork walls, and ordinary building papers.

Materials used.—Paper used in test No. 1—oiled paper—thickness 10/1000 of an inch weight per square foot=5¼ pounds.

Paper used in test No. 2—trade name Clima—sat-building paper, advertised an acid, salt, alkali and waterproof, thickness 18/1000 of an inch, weight per 100 sq. feet=10.4 lbs.

Test No. 3 was made to test a wall of planer shavings 6″ thick. A frame 6″ deep shown on sketch No. 3 as style D was made of ⅞″ boards. A wire screen, 12 mesh to the inch was fastened to each side of the frame and shavings packed between the screens giving a wall of shavings 6″ thick.

For details of walls used in tests No. 4, No. 5 and No. 6, see sketch No. 2.

Cork walls used in tests No. 8, No. 9 and No. 10 were made of slabs of pressed cork 1½″ thick x 12″ wide x 3′ long.

We wish to acknowledge assistance given by Professor Angus of the Mechanical Engineering Department, University of Toronto, James Govan, Architect, Department of the Provincial Secretary of the Ontario Government and the Asbestos Manufacturing Co. of Montreal which furnished the Asbestos products tested.

LOG SHEET OF RESULTS TESTS MADE IN 1914

Date	No. of test	DESCRIPTION OF MATERIAL TESTED	Average Temperature			Total watts	No. of sq. ft. of wall surface	Transferred per sq. ft. per degree diff. of temp. per hr.
			Room	High side	Low side			
1914 Nov. 6	1	1 ply oiled paper	70	71	31.5	320.25	20	1.38
Nov. 9	2	1 ply climasat water proof building paper	68	68	26	297.6	20	1.21
Nov. 12	3	Wall shown on sketch No. 2 marked D	72	69	20	79.3	20	0.276
Nov. 13	4	Wall shown on sketch No. 2 marked A	70	70.25	20.8	41.49	21.335	0.134
Nov. 17	5	Wall shown on sketch No. 2 marked B	69.75	68.7	20.2	63.84	21.335	0.205
Nov. 19	6	Wall shown on sketch No. 2 marked Style C, filled with saw-dust	69	70	18.75	47.0	21.335	0.147
Nov. 20	7	1 layer of hair felt held together between two sheets of thin paper	72	69.5	26.9	144.17	20	0.578
Nov. 23	8	Style C, hollow space filled with granulated cork	68.0	70.0	18.1	46.94	21.335	0.144
	9	3″ cork wall made up of 2 layers 1½″ thick with 1 layer of paper between the 1½″ layers of cork	72.5	70.3	19	41.47	21.11	0.130
	10	The preceding test repeated	72.0	69.8	18.33	42.0	21.11	0.131

For details of walls marked A, B, C, D, see sketch No. 2.

MISCELLANEOUS MATERIALS TESTED SINCE 1914

Date	No. of test	DESCRIPTION OF MATERIAL TESTED	Average Temperature			Total watts	No. of sq. ft. of wall surface	Transferred per sq. ft. per degree diff. of temp. per hr.
			Room	High side	Low side			
1917 Nov. 22	1	Corrugated galvanized iron wall supported on 2 × 4 frame	67	69.6	19.7	368	21	1.2
Dec. 4	2	Wall made up of corrugated galvanized iron on one side of 2 × 4 frame and ⅞ T. & G. spruce sheathing on other side	69	68.4	18.1	168.8	21	0.55
1918 Jan. 24	3	Beaver Board 3/16″ thick	65	68.9	22.5	230	20.3	0.83
Feb. 18	4	Linabestos ball board 3/16″ thick dark red in color made up of asbestos and concrete	67	71	20.6	389.5	20.3	1.305
Feb. 22	5	Asbestos lumber 3/16″ thick	67	69.7	21	345.5	21.2	1.14
Feb. 28	6	Asbestos corrugated sheathing 2/16″ thick	68	70.3	22.3	340.3	21.2	1.13
Mar. 11	7	Asbestos shingles laid on 1 layer paper and ⅞ T. & G. sheathing, laid 7″ to the weather, size of shingles 16 × 16 × 3/16″	67	71.1	18.9	137.75	21.2	0.442

The composition of the asbestos products is approximately 15% asbestos and 85% portland cement.

REVISION OF BY-LAWS

At the meeting of the Council held on Tuesday, November 26th, the Special By-Laws Committee, consisting of H. R. Safford, Chairman, Ernest Brown and Walter J. Francis and President Vaughan, ex-officio, presented its report, suggesting changes in the by-laws, which report was adopted.

The changes suggested are mainly verbal and do not affect the sense of the by-laws. A new by-law has been proposed dealing with the Adoption of Specifications; the by-law relating to Fees has been revised and new by-laws introduced referring to Notices and to The Journal of the Institute.

The proposals published below may be compared with the By-Laws as they appear in the "Charter, By-Laws, List of Members and Roll of Honour" just mailed to the membership. Members should be conversant with the proposed changes, upon which a vote will be taken, after discussion at the Annual General Meeting.

The publication herewith of the proposed amendments constitutes the official notice to the membership of suggested amendments, as required in Section 73 of the By-Laws, and includes only those by-laws in which changes are proposed:

Students.

Section 10.—A Student shall be at least seventeen years of age, and shall present a certificate of having passed successfully an examination equivalent to the final examination of a High School or the matriculation of an Arts or Science course. He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination equal to that prescribed for admission to the grade of Junior in the foregoing section. He shall not remain in the class of Student after he has attained the age of twenty-five years.

Term of Office—Vacancies.

Section 13.—The term of office of the President shall be one year; of the Vice-Presidents two years; and of the Councillors three years. Two Vice-Presidents and ten Councillors, in addition to any required to fill vacancies, shall be elected annually.

The term of each Officer shall begin at the close of the Annual General Meeting at which such Officer is elected, and shall continue for the period above named or until a successor is duly elected or appointed by the Council.

A vacancy in the office of President shall be filled by the Senior Vice-President. Seniority shall be determined by priority of election to the office of Vice-President, and, failing that, by priority of admission to Corporate Membership.

A vacancy in the office of Vice-President shall be filled until the following annual election by the Senior Councillor. Seniority shall be determined by priority of election as a Councillor, and, failing that, by priority of admission to Corporate Membership.

A vacancy in the office of Councillor shall be filled by the Council until the following annual election.

The Secretary.

Section 16.—(Fourth paragraph)

He shall see that all moneys due to the Institute are carefully collected, and deposited with the funds of the Institute.

The Treasurer.

Section 17.—The Treasurer shall be a Corporate Member of the Institute. He shall be appointed by the Council and shall hold office subject to removal by an affirmative vote of a majority of the Council.

He shall prepare and present annually to the Council in time for the Annual General Meeting a financial statement, as of the 31st December, of the affairs of the Institute. He shall furnish from time to time such other reports as may be prescribed.

He shall, with the Secretary, invest the funds of the Institute as may be ordered by the Council.

Appointment of Secretary-Treasurer and Committees.

Section 18.—The Council shall meet within seven days after its election and shall then appoint the Secretary, the Treasurer, and the following Standing Committees:—

A Finance Committee of five members.

A Library and House Committee of five members.

A Papers Committee as prescribed in Section 21.

A Publication Committee of five members.

A Legislation Committee of three members.

The Chairman of each Standing Committee shall be a member of the Council.

Standing Committees shall perform their duties under the supervision of the Council, and shall report to the Council.

The Council may at any time appoint such other committees as it may consider desirable.

Papers Committee.

Section 21.—(Second paragraph)

Papers which have been published previously, which specially advocate personal interests, which are prepared carelessly, which controvert established facts or are purely speculative or foreign to the objects of the Institute, shall not be accepted.

Publication Committee.

Section 22.—(Third paragraph)

All papers which have been accepted for publication shall be the property of the Institute. Any paper which has not been accepted shall be returned promptly to the author.

Legislation Committee.

Section 23.—The Legislation Committee shall consider all suggestions and reports concerning legislation which may be made by a Branch or Provincial Division. It shall keep itself advised of all legislation, either actual or proposed, which is likely to affect the interests of the Institute or of its members, and shall report to the Council thereon.

Special Committees—Adoption of Specifications.

(New By-Law. Replaces Section 24.)

Section 24.—(a) *Special Committees.*—The Council, at any time, may appoint Special Committees to report upon engineering subjects or upon other matters of interest to the Institute. The Annual General Meeting may recommend to the Council, the appointment of Special Committees, and such recommendations shall be considered by the Council at the first meeting following the Annual General Meeting.

Special Committees shall perform their duties under the supervision of the Council, and shall report to the Council.

(b) *Adoption of Specifications*—Specifications of the Institute shall be adopted by letter ballot of the Corporate Members.

Reports of Special Committees on Specifications shall be issued to the membership after presentation to the Council, and shall be open for discussion by all members for a sufficient period. All discussion thereon shall be forwarded to the Special Committee by a date fixed by the Council, and the Committee shall then present a final report to the Council, which report shall be issued to the membership, and the Council shall determine whether it shall be voted upon for adoption by the Institute. If the report be submitted for adoption, the Secretary shall issue a letter ballot to Corporate Members in a form prescribed by the Council, and an affirmative vote of two-thirds of all valid ballots shall be necessary for adoption. The ballot shall be canvassed by scrutineers appointed by the Council, and the result of the voting shall be announced to the membership.

ADMISSION, TRANSFER AND EXPULSION OF MEMBERS.

Honorary Members.

Section 25.—Honorary Members must be elected by a unanimous vote of the Council, one month's notice having been given to the Members of the Council of the names of the nominees, and of the meeting at which it is proposed to make the nomination. The election of Honorary Members shall be by vote of the Council, given in the same manner as in the election of Members. The number of Honorary Members shall not exceed twenty.

The Secretary shall write the Honorary Member advising him of his election, and shall request him to notify the Institute by letter of his acceptance within three months. Failing such acceptance, his election shall be void.

Applications for Admission or for Transfer.

Section 27.—Applications for admission to the Institute (Form A in the Appendix), or for transfer from one class to a higher (Form B in the Appendix), shall contain a statement, over the applicant's signature, of his age, residence, the nature and term of his professional service, and an agreement to conform to the regulations of the Institute if elected or transferred. The applicant shall give as references the names of at least five Corporate Members, from whom the Council shall obtain satisfactory evidence in writing that they know the applicant personally, and that he is worthy of admission or transfer. The application of a Student shall require the name of only one Corporate Member as a reference.

Consideration of Applications.

Section 28.—The Secretary immediately upon receipt of an application shall forward copies of all papers and correspondence in connection therewith to the Secretary of the Branch which is located most nearly to the residence of the applicant. The Executive Committee of the Branch shall thereupon make such inquiries concerning the applicant as it deems to be advisable, and shall recommend to the Council the action that it considers should be taken with reference to the application.

At stated periods to be determined by the Council there shall be issued to Corporate Members whose addresses are known, a list of new applicants for admission or for transfer, containing a concise statement of the record of each applicant and the names of his references, with a request that members transmit to the Secretary any information in their possession which may affect the classification or eligibility of the applicant.

The Council shall consider all the information with reference to the applicants, making further inquiries if deemed expedient, and shall then decide on the class of membership for which each applicant is qualified.

Election and Transfer.

Section 29—Members shall be elected or transferred by letter ballot of the Council in a form to be prescribed by the Council. The ballot shall be mailed to each member of the Council, and shall state the date on which it is proposed to canvass the ballot, which shall not be less than twenty days after the issue of the ballot. At least twenty votes shall be cast to constitute an election. Three or more negative votes shall exclude from election. In case of exclusion no notice thereof shall be entered in the minutes, but the candidate shall be notified. A rejected candidate may renew his application for membership or transfer at any time after the expiration of one year from the date of the ballot rejecting his previous application.

Notification of Election.

Section 30.—On the admission of a candidate, he shall be notified by the Secretary (Form C in the Appendix). On receipt of the notification he shall subscribe to the Charter and By-Laws (Form D in the Appendix), and pay to the Institute the prescribed fees. He shall then be entitled to the privilege of membership. Membership shall date from the day of admission.

Certificate of Membership.

Section 31.—A certificate of membership shall be issued to all members on election which shall be the property of the Institute. This certificate shall be returned by any member who has resigned, or whose name has been removed from the list of members on his receipt of notice of such removal or of acceptance of resignation.

Expulsion and Discipline.

Section 32.—The Council shall have the right, by a majority of at least four-fifths of those present at a meeting of the Council, to expel from the Institute any Corporate or Non-Corporate Member who may be convicted, by a competent tribunal, of felony, embezzlement, larceny, misdemeanour, or other offence, which, in the opinion of the Council, renders him unfit to be a member.

In case the Council shall be of the opinion that the conduct of any Corporate or Non-Corporate Member should become the subject of inquiry with the view to ascertain whether there are grounds for disciplining or expelling him, or in case twenty or more Corporate Members shall think fit to draw up and sign a request for such an inquiry regarding a Corporate or Non-Corporate Member on any ground whatever, and shall deliver the same to the Secretary to be laid before the Council for consideration, the Council shall make such inquiry as they deem adequate, and if they do not find sufficient reason for disciplining or expelling the said member, no entry of the inquiry shall be made in the minutes; but if the Council, by a majority of at least four-fifths of those present at the meeting of the Council especially summoned for the purpose and at which at least twelve members of the Council are present, do find good reason for expelling or otherwise disciplining the said member on the ground that he has been guilty of improper conduct, they shall cause the name of such person to be erased from the list of members and thus expel him from the Institute or otherwise discipline him at their discretion. The Secretary shall forthwith notify the member of the decision of the Council and, should the member be expelled, the Council shall report such expulsion at the next Annual General Meeting.

FEES

Entrance Fees.

Section 33.—The Entrance Fees payable by those admitted to the Institute shall be as follows:—

Members	$25.00
Associate Members	15.00
Juniors	10.00
Associates	15.00

Honorary Members and Students shall be exempt from Entrance Fees.

Annual Fees.

Section 34.—The Annual Fees payable by Residents shall be as follows:—

Members	$13.00
Associate Members	10.00
Juniors	6.00
Students	1.00
Associates	13.00

The Annual Fees payable by Branch Residents shall be as follows:—

Members	$10.00
Associate Members	8.00
Juniors	4.00
Students	1.00
Associates	13.00

The Annual Fees payable by Non-Residents shall be as follows:—

Members	$ 8.00
Associate Members	6.00
Juniors	3.00
Students	1.00
Associates	13.00

Honorary Members shall be exempt from Annual Fees.

Liability.

Section 36.—Any person once admitted to the Institute shall belong thereto, and be liable for the payment of all fees until he shall have resigned, have been expelled, or have been relieved from payment by the Council.

Arrears—Exemptions—Retired List.

Section 38.—The Secretary shall notify any member whose fees become more than three months in arrears. Should the fees become six months in arrears, the member shall lose the right to vote or to receive the publications of the Institute. Should the fees become nine months in arrears, the member shall again be notified in form prescribed by the Council, and if such fees become one year in arrears, he shall cease to be a member of the Institute. The Council, for cause deemed by it sufficient, may extend the time for payment and for the application of these penalties.

The Council may for sufficient cause, temporarily excuse from payment of annual fees any member who from ill health, advanced age or other good reason assigned, is unable to pay such fees, and the Council may remit the whole or part of fees in arrears.

The Council, upon written request, and at its discretion, may exempt from further payment of annual fees, any Corporate Member who has reached the age of sixty-five, or who has been a Corporate Member for thirty years. The names of such members shall be placed on a "Retired List."

Transfer.

Section 39.—A member when transferred from any one class to any other shall pay the difference between the entrance fee of the two classes except as provided in By-Law 41.

Re-admission.

Section 41.—The Council, at its discretion, may re-admit, with or without the payment of a second entrance fee, any person who has resigned or who has ceased to be a member for non-payment of fees, provided that all arrears have been paid.

MEETINGS

Annual General Meeting.

Section 42.—The Annual General Meeting of the Institute shall begin on the fourth Tuesday in January, or on such other day in January as the Council may direct, and notice thereof shall be mailed to the members twenty-one days before the date of the meeting.

The Council shall lay before the meeting a report of the proceedings of the Institute for the year ended on the thirty-first day of December preceding. This report shall be approved by the Council and be signed by the President and the Secretary. The financial statement of the Treasurer and the reports of Standing Committees, Branches, Provincial Divisions and such other reports as the Council may determine, shall be presented. The address of the retiring President shall be delivered. The vote for the election of Officers for the current year shall be announced. Any other business of interest to the Institute may be brought before and transacted at the meeting.

Council may adopt, from time to time, rules for the order of business at Annual General Meetings, which shall be printed in the notice calling the meeting.

Thirty Corporate Members shall constitute a quorum.

Special General Meetings.

Section 43.—Special General Meetings of the Institute may be called by the Council, and shall be so called on receipt of written requests from thirty Corporate Members or from a majority of the Branches. The notice for such a meeting shall state the specific object thereof and shall be mailed at least thirty days before the date of the Meeting. No other business shall be taken up.

Thirty Corporate Members shall constitute a quorum.

Meetings of Council.

Section 45.—The Council shall meet at least once each month, from the beginning of October to the end of April, and at such other times as may be deemed necessary.

Five members shall constitute a quorum.

Meetings of Standing Committees.

Section 47.—Standing Committees except the Papers Committee shall meet at least once each month, from the beginning of October to the end of April, and at such other times as may be deemed necessary.

Three members shall constitute a quorum.

Presiding Officer.

Section 48.—In the event of the absence of the President, one of the Vice-Presidents, or in the event of their absence, a Member of the Council, shall preside at all meetings of the Institute and of the Council.

In the absence of the Officers above mentioned, the meeting shall select a member to act as Chairman.

Branch Membership.

Section 50.—The membership of a Branch shall consist of the members of the Institute of all classes residing within a distance, of twenty-five miles from the headquarters of the Branch and of those residing at a greater distance, who desiring to join the Branch, so notify the Secretary-Treasurer of the Branch, who in turn shall notify the Secretary of the Institute.

Branches may at their option admit to membership persons not members of the Institute, who shall be termed "Affiliates of the Branch".

Sections of Branches.

Section 53.—At the request of ten Corporate Members of a Branch made in writing to the Secretary of the Branch, and approved by the Executive Committee, sections of the Branch shall be established, corresponding to any of the generally recognized branches of the engineering profession, such as Chemical, Civil, Electrical, Mechanical, Mining, etc.

The Chairman of the Branch shall be ex-officio the Chairman of each Section of the Branch, and each Section of the Branch shall have as executive officer a Vice-Chairman, who shall be appointed by the Executive Committee at its first meeting after the Annual Meeting of the Branch, or on the authorization of any Section of the Branch. He shall hold office for one year from the first day of June next following the date of his election.

By-Laws.

Section 54.—Branches shall adopt By-Laws governing the election of Officers, the holding of meetings, and other matters of local jurisdiction. As far as possible, there shall be uniformity in the By-Laws of all Branches of the Institute. The draft of the By-Laws, and of amendments or additions thereto, shall be submitted to the Council for tapproval, and shall then be submitted by letter ballot to the vote of he Corporate Members of the Branch for final adoption.

Functions.

Section 55.—The Branches shall promote the objects and interests of the Institute, and shall encourage the preparation of papers and addresses on engineering subjects or on subjects of scientific or engineering interest, both for presentation at meetings of the Branch, and of the Institute.

Revenue.

Section 57.—The Secretary of the Institute shall each year remit to each Branch, except the Montreal Branch, twenty-five per cent. of the annual fees, current or arrears, received from the members of that Branch during that year, payments being made quarterly. A statement showing the individual amounts, and from whom collected, shall accompany each quarterly remittance.

For the purpose of this By-law, the Branch Membership list shall be revised on the first day of January and the first day of July in each year, but the change shall not be retroactive except in the case of new admissions to the Institute.

PROVINCIAL DIVISIONS.

Section 59.—A Provincial Division of the Institute may be established under the authority of the Council, at the request of a majority of the Corporate Members residing in any province. Members of the Institute, of all classes, residing within such province, shall be members of the Provincial Division so formed.

Management.

Section 60.—A Provincial Division shall be managed by an Executive Committee consisting of the Councillors resident in the Provincial Division, one member from each of the Branches established in the province, and representatives elected by the Non-Resident Corporate Members within the province as follows:—Where the Non-Resident membership numbers fifty (50) or less there shall be two representatives; where the Non-Resident membership exceeds fifty (50) there shall be one representative for each twenty-five (25) members.

All members of the committee shall be Corporate Members, and four members shall constitute a quorum.

Officers.

Section 61.—The Officers of a Provincial Division shall be a Chairman, and a Secretary-Treasurer, or a Secretary and a Treasurer, who shall be elected by the Executive Committee of the Division.

By-Laws.

Section 62.—Provincial Divisions shall adopt By-Laws governing the election of Officers, the holding of meetings, and other matters of local jurisdiction. As far as possible, there shall be uniformity in the By-Laws of all Provincial Divisions of the Institute. The draft of the By-Laws, and of amendments or additions thereto, shall be submitted to the Council for approval, and shall then be submitted by letter ballot to the vote of the Corporate Members of the Provincial Division for final adoption.

Reports.

Section 63.—The Secretary of a Provincial Division shall transmit to the Council, copies of minutes of all meetings and reports of all proceedings of the Division. He shall also present an Annual Report to the Secretary of the Institute, who shall present it to the Annual General Meeting of the Institute.

Election of Nominating Committee.

Section 67.—The Nomination of Officers for the Institute shall be made by a Nominating Committee. The Honorary Councillors shall be ex-officio members of this Committee, The remaining members, who shall not be Officers of the Institute shall be elected annually as follows:—For District No. 1, the Montreal Branch shall appoint two members; each other Branch shall appoint one member; for each District in which no Branch exists, the Council shall appoint one member. The membership of the Committee shall be announced at the Annual General Meeting.

Nominating Committee to prepare Officers' Ballot.

Section 68.—The Nominating Committee shall prepare an Officers' Ballot, which shall contain the names of not less than two nominees for each office to be filled, with the exception of that of President, for which only one name may be submitted.

The nominees for Vice-President shall be so selected that there shall be one Vice-President resident in District No. 1, and the other districts shall be fairly represented.

The nominees for Councillors shall be such that two shall be elected who are resident in District No. 1, and one in each of the remaining eight Districts.

The Officers' Ballot shall be presented to the Council by the Nominating Committee not later than the first day of October, and shall be accompanied by a letter of acceptance of nomination from each nominee.

The Council shall examine the Officers' Ballot submitted by the Nominating Committee. If the Council find a nominee ineligible for the office for which he is nominated, or should the consent in writing of a nominee to appear on the Officers' Ballot not be furnished, or should any nominee after such consent withdraw his name, such name shall be deleted, and the Council shall substitute another name therefor. The words "Proposed by Nominating Committee" and "Proposed by Council" shall be printed conspicuously on the ballot, to indicate the manner of nomination of all nominees.

Nominees for Officers' Ballot sent to Members.

Within seven days after the first meeting of the Council in October, the Secretary shall mail to each Corporate Member of the Institute the Officers' Ballot, as prepared by the Nominating Committee and the Council.

Additional nominations for the Officers' Ballot signed by ten or more Corporate Members and accompanied by written acceptances of those nominated, if received by the Secretary on or before the first day of December, shall be accepted by the Council and shall be placed on the ballot. The words "Special Nomination" shall be printed conspicuously near such names, and the names of the members making such nominations shall be printed on some part of the ballot.

The Officers' Ballot.

The Officers' Ballot shall be mailed to Corporate Members at least thirty days before the Annual General Meeting, and shall state the name and residence of each nominee, his class of membership and the District in which he resides. The names of the nominees for any one office shall be arranged alphabetically by Districts.

Voters may strike out names from the Officers' Ballot and may substitute other names therefor, but the number of votes cast for each office must not exceed the number to be elected to such office. In voting for Councillors, each voter shall vote only for the Councillors to be elected from his own District. Directions in accordance with the above provisions shall be printed conspicuously on the ballot, and any vote which does not comply with them shall be rejected.

Elections.

Section 70.—The nominee receiving the highest number of votes for any office shall be declared elected to such office.

Section 71.—In case of a tie between two or more nominees for the same office, the Corporate Members present at the Annual General Meeting when the result of the ballot is announced, shall elect by ballot the officer from among the nominees so tied. In case of a further tie the Presiding Officer shall cast the deciding vote.

JOURNAL OF THE INSTITUTE

Section 73.—Members of all classes shall subscribe for the Journal of the Institute, (Form E in the Appendix), and the subscription shall be payable on the first day of January of each year.

The annual subscription for the Journal, for members of the Institute, shall be two dollars.

NOTICES

Section 74.—Notices shall be deemed to have been mailed to members as prescribed by the By-Laws if such notices are printed in the Journal of the Institute and mailed by the dates prescribed in the By-laws.

AMENDMENTS.

Section 75.—Proposals to introduce new By-laws or to amend or repeal existing By-laws shall be presented in writing to the Council, signed by at least twenty Corporate Members, and shall reach the Secretary not later than the first day of October. The Council shall consider the proposals and the proposers shall be notified of the opinion of the Council in regard thereto not later than the seventh day of November. The proposers may then withdraw their proposals, accept any changes suggested, or insist on the original form, sending their decision to the Secretary not later than the fifteenth day of December. The proposals, as accepted by the proposers, shall be mailed to Corporate Members not less than twenty-one days before the Annual General Meeting. Proposals to introduce new By-laws or to amend or repeal existing By-Laws, may also be made by the Council and shall be mailed to Corporate Members not less than twenty-one days before the Annual General Meeting.

All proposals shall be submitted for discussion at the Annual General Meeting and shall then be submitted by letter ballot to the Corporate Membership of the Institute. The Secretary shall issue the letter ballot not later than two months after the Annual General Meeting. The reasons advanced for and against the proposals edited by a Committee appointed by the Chairman consisting of an equal number of members favouring and members opposing the proposals shall accompany the letter ballot. The letter ballot shall be returnable to the Secretary not later than three months after the Annual General Meeting. Scrutineers appointed by the Council shall immediately thereafter count the ballots and report the result to the Council.

An affirmative vote of two-thirds of all valid ballots shall be necessary for the amendment or repeal of existing By-laws, or for the adoption of new By-laws.

The By-laws as revised shall take effect forthwith, except that changes affecting the tenure of office of an Officer of the Institute shall not take effect until the next annual election.

The Khaki University of Canada

By Frank D. Adams, D. Sc., Hon. M.E.I.C.

While the work of an army is for the most part necessarily of a destructive character, the Khaki University, which now forms part of the regular Canadian Army, is carrying on constructive work of the highest order. The idea originated with the Canadian Y.M.C.A., assisted by the Chaplain Service and many voluntary workers, to provide a means whereby the soldiers of our army may make use of the time which is not directly occupied in military training in carrying on their education and preparing themselves for their return to civil life when the great war is over. The work has proved to be so valuable that it has commended itself very strongly to the General Staff of the army, as well as to the Military Authorities in the various areas where the work has been conducted. When the Right Hon. Sir Robert Borden was in England last, a full Report of the work as then in operation was submitted to him by the Head of the University, Dr. H. Marshall Tory, well known as the President of the University of Alberta. In this Report a very interesting account of the work already done by the Khaki University was given, as well as an outline of the work which might be undertaken by the University, provided an adequate staff were available, more especially during the period of demobilization, when the war would be over, and the whole army would be in France and England awaiting such time as it could be sent home to Canada.

The Government, after a careful consideration of this Report, last September passed an Order in Council constituting the Khaki University as an integral part of the Canadian army under the direction of the Head-quarter Staff, and designated as The Educational Services of the Overseas Military Forces of Canada. It still, however, also retains the name of The Khaki University of Canada.

The Order in Council provides for a regular establishment, consisting of a maximum of 240 officers and men,

chosen from the Canadian army. This staff, before enlistment, were for the most part connected with the Universities, Schools, and other educational institutions in Canada, and are thus equipped for the educational work which they are now called upon to do. A certain number of leading men from the Universities and Colleges of Canada will be invited to join the staff, these being more especially men who are leading authorities in their respective subjects, and are thus in a position to assist in the organization and development of certain Faculties of the Khaki University.

Pursuant to this Order in Council, Dr. H. M. Tory, President of the University of Alberta, has been appointed to take charge of this establishment, with the title of Director of the Educational Services of the Overseas Military Forces of Canada. Dr. Frank D. Adams, of McGill University, has been appointed Deputy Director of these Services.

A body composed of representatives from all the Universities of Canada, with an executive in London, works in close co-operation, and thus an intimate bond of union is established between the Khaki University and the Canadian Universities.

Arrangements have already been made whereby the work done in the Khaki University will be accepted by the Canadian Universities as equivalent to their own, in so far as it covers the same ground. It will thus be possible for a soldier, while in the army, to complete his Matriculation Examination, the First or Second years, or even work of higher years in the Canadian Universities. In this way he may, while still in the army, continue his university course.

It might at first sight be supposed that a soldier on Active Service has little leisure for study. Some have even expressed the opinion that the thoughts of every soldier should be continually directed to, and fixed upon, one subject, namely the destruction of his enemies. Whilst both of these views are true in the case of the soldier in the "Corps," those who happen to be actually in the trenches with the enemy across the top, or in the immediate reserves and supports, it must be remembered that a large proportion of any well-organized army is never so placed at any one time. The great body of the Canadian Forces for instance, is at any one time situated behind the actual front, being in rest billets, transportation services, training camps, convalescent hospitals, etc. There are also great bodies of non-combatants, engaged in railroad construction, the making and repairing of roads, and in the transport service. The Canadian army also has some thirty thousand men in the Forestry Battalions. All these men have a good deal of spare time, and the offer of facilities for study and instruction has been very keenly welcomed and accepted by them. The men in the training camps as a general rule have no work after 4.30 p.m., and the instructional classes, libraries and reading rooms of the Khaki University are crowded every afternoon and evening.

The University has "Colleges" in all the larger military camps and hospitals in France and England, and is now rapidly extending its work to other areas. When the work is fully organized there will be no man in the army who is beyond the reach of instructional work through the University. Where actual teachers cannot be provided the men will always be able to secure instruction, necessary textbooks, etc., through the Correspondence Department. Already twelve thousand men are enrolled in the Khaki University, of which number about three thousand are taking work by correspondence. At the present time three groups of subjects are attracting the largest number of students. These are, Agriculture, Engineering, and Commercial subjects. There are at the present time over two thousand men taking instruction in work connected with Engineering. This instruction consists of courses dealing with the Steam Engine, with Internal Combustion Engines, Wireless Telegraphy, with smaller classes in Surveying, Strength of Materials, Bridge Construction, etc. The courses are graduated into Elementary, Intermediate and Advanced Courses in each subject. Many of the men have become so proficient in the work that their services have been in active demand by the transport officers of the army. Many of the students in the courses of Internal Combustion Engines and their uses are men intending to take up farming on their return to Canada, and who desire to familiarise themselves with the handling of farm tractors and other power farming machinery which now form such an important factor in the successful prosecution of modern farming. These men, with the additional training which they have received through the army and by means of the Khaki University, will, on their return to Canada, be a not unimportant factor in the development of the industrial life of the country. A large number of men also are taking courses in Agriculture in view of taking up land in Canada when the war is over, either on their own account, or under the provisions of the Soldiers Settlement Act, while the work in Commercial subjects follows along the lines of the best instruction given in Canada for men who are preparing themselves for business careers.

The Educational Services of the Canadian Army represents a new line of work in the activities of an army. It has, however, commended itself so highly to the armies of the other Oversea Dominions, as well as of the Mother Country, that they have followed the lead of Canada in this respect, and the staffs of the army of Australia, of New Zealand and of Great Britain itself are now engaged in organizing a similar Service for their respective forces, whilst the staff of the army of South Africa are investigating the methods of the Canadian Educational Services with a view to providing the soldiers from South Africa with similar educational advantages.

In the period of demobilization the work of the University will greatly expand, and will, so far as possible, concentrate in certain great camps. From the present outlook it seems very probable that the Khaki University of Canada will, during this period, have at least fifty thousand students.

Lignite Utilization Board of Canada

To those who may become interested in a business way in the actives of the Lignite Utilization Board of Canada the following information is addressed:

Constitution — The Board is created by an Order-in-Council of the Dominion of Canada supplemented by an agreement as to finances with the Provincial Governments of Manitoba and Saskatchewan, by which the three governments have appropriated $400,000 for the use of the Board.

Business Status — In its relation towards business interests, the Board has the powers of an incorporated company to buy, sell, make contracts, hold property, etc. In its relation to the Government, it is a trust, holding and expending funds provided by the governments, and having power to hold property in trust.

Reason for Creation of Board — The citation of part of the Order-in-Council will give clearly the reasons for the creation of the Board:

> "That there are large deposits of lignite underlying various districts of the Provinces of Saskatchewan and Alberta, some of which, in the raw state can only be utilized when freshly mined, and are, moreover, unsuited in such state to household use:"
>
> "That by carbonizing this lignite a coke or charcoal is obtained which briquettes readily and, without consideration of the by-products such as oil, pitch, ammonia sulphate, gas, etc., the result is to turn two tons of inferior fuel into one ton of briquettes approximating, in heating value, anthracite coal with practically the same heating value in the domestic furnace as the two tons from which it was made;"

Immediate Objective — The immediate objective of the Board is the carbonizing and briquetting of the lignites of southern Saskatchewan for domestic use.

Programme — To reach this objective the following will be the steps undertaken:

(a) A thorough investigation will be made of all machines and processes in use on this continent covering carbonization of coal, the use of binders, and briquetting.

(b) With full information at hand regarding machinery and processes, the Board will construct or contract for a plant of commercial size adjacent to the developed mines of southern Saskatchewan.

(c) After operations are developed to a point where a commercial product may be obtained, the Board will distribute its output through the ordinary channels of trade.

(d) While the production of domestic fuel is the immediate objective, the by-products derived therefrom will be studied, as will also the use of carbonized or powdered fuel for commercial power purposes.

Notes — It is proposed that the capacity of the carbonizing and briquetting plant shall be not less than ten tons per hour.

Western Canada has heretofore imported about 500,000 tons of anthracite from Pennsylvania at a cost of about $5,000,000 per annum.

Canada's coal resources are greater than those of any country in the world, with the exception of the United States. Much of Canada's coal, however, requires treatment before being available for satisfactory domestic use.

It is expected that a successful outcome of the development undertaken by the Board will result in the establishment of an industry of national importance.

Personnel—The personnel of the Board appointed by Order-in-Council of the Dominion Government is as follows:— R. A. ROSS, Consulting Engineer, Montreal, Chairman; The Honorable J. A. SHEPPARD, Moose Jaw, Sask.; J. M. LEAMY, Provincial Electrical Engineer of the Government of Manitoba, Winnipeg.

Staff — The Board has appointed the following staff:—LESSLIE R. THOMSON, A.M.E.I.C., Secretary; EDGAR STANSFIELD, M.E.I.C., Chemical Engineer; R. DeL. FRENCH, M.E.I.C., Engineer.

Address — For the immediate present, work will be carried on in Montreal at the address given below, but, thereafter it is anticipated that headquarters will be established at some point in the western provinces of Canada.

Address all correspondence to Lesslie R. Thomson, Secretary, Lignite Utilization Board, 80 St. Francois Xavier Street, Montreal.

R. A. ROSS,
Chairman.

Montreal, October 1st, 1918.

* * *

Stefanson's Report to Government:

G. J. Desbarats, C.M.G., M.E.I.C., Deputy Minister and Comptroller of the Naval Service, Ottawa, received the official report on October 29th from Vilhjalmur Stefansson, commander-in-chief of the Polar expedition, which left Ottawa in May 1913, having been commissioned by the Department of Naval Service to explore the unknown regions of northern Alaska and west of the known Canadian lands. The scientific material available as the result of this trip is enormous, and according to Mr. Desbarats, publication of this is under way. The explorer has added to Canada several unknown lands in the Arctic regions, and added much useful information to that already available regarding the Arctic. At certain points where land was supposed to exist, he discovered that there was only ocean. He discovered coal and found that copper existed in large quantities. The expedition started out with the ill-fated Karluck, with what was probably the finest equipment of scientific apparatus ever gathered for a Polar expedition, all of which was lost with the vessel. In spite of many hardships, delays and tragic incidents, the expedition accomplished more even than had been expected.

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOL. I. NO. 8 DECEMBER 1918

The Engineering Institute of Canada
INCORPORATED IN 1887 AS
The Canadian Society of Civil Engineers.

To Our Members Overseas.

The Council and Members of The Engineering Institute of Canada consider it a happy privilege to be able to again greet you and extend to you the cordial good wishes of your fellow engineers in Canada.

Canadians at home are proud of their gallant men at the front and we as engineers have particular reason to be thrilled by what our fellow members have accomplished. Many of you have performed deeds that have brought immortal glory to the name of Canada.

It is with justifiable pride in you, that we send you a slight remembrance and in doing so, express the hope that in a short time, complete victory may have been attained and that you may soon again be with us in the full enjoyment of health and strength.

On behalf of the Institute,
Fraser S. Keith, Secretary.

Annual General Meeting

As mentioned in the last issue of *The Journal*, the Annual Meeting will be held in Ottawa in combination with a general professional meeting. To comply with the By-Laws the Annual Meeting will be called for January 28th, in Montreal, to be adjourned to the Chateau Laurier in Ottawa on February 11th. At the meeting in Montreal the auditors will be appointed and scrutineers named to count the ballot, the result of which will be announced at the business meeting in Ottawa.

The Ordeal Past

The consummation of a world wide wish, a longing of four weary years, arrived with startling suddenness when on November the eleventh, the envoys of Germany signed the armistice terms imposed by the Allies. By these terms, which include the evacuation of occupied territory, the forfeiting of most of the German fleet and the occupation by the Allies of German territory, it seems evident that the ruthless foe of civilization would be impotent to renew hostilities. Peace then is at hand with all it means to a world convulsed by war's dread alarms and stricken by its heartbreaking fruits. Never in the whole history of the human race have more momentous events transpired than within the past month. The hun has met with inglorious defeat, has admitted the superiority of the Allies in the test of arms in which he has claimed to be supreme. His monstrous designs and absolute guilt in planning the great war are becoming more evident every week. In all his plans he overlooked one vital consideration and it inspired the greater nations of the world to rise against him — the love of freedom so universally implanted in the hearts of mankind,— the converse of the German junkers' creed. The historian of the future will obtain a perspective more in keeping with transpiring events than is possible for us at present.

With the end of the war assured there exists instead of a great jubilation of spirit, a serious note of thanksgiving, amounting almost universally to a heartfelt prayer of thanks that the horrors of the past four years have been brought to an end.

What of the future?

The whole economic and moral fabric of mankind have been shaken and torn asunder and will not again be the same. The engineering profession has played a big part in accomplishing the defeat of the hun. The infinitely superior engineering skill and knowledge of the Allies combined with the higher moral tone and standard have been the big factors. Engineers are proud of what has been accomplished by their fellows in the field and in the factory. What part are we going to take in the reconstruction of the material things, which need replacing, and the social system which the war has brought into a state of rapid evolution? What is our individual sense of responsibility regarding the leadership which the members of this organization should take in connection with assisting to solve the problems facing mankind. Governments are for the most part made up of men not trained, as is the engineer, to definite accomplishment in matters such as evolving a more definite system of technical education, helping to solve the labour situation,

the reconstruction, not only of devastated areas but of countries needing development, the utilization of our own vast natural resources and assisting Canada in a collective manner to grow strong and wealthy, that the financial burdens gathered may be easily borne, therefore in these things we must play a very important part. Just what part we may take does not rest with the Council nor the management but is dependent upon how much the average member is concerned. If we are to take a share, as we should, every member of the organization must be prepared to give them thought as to how we can, to the best advantage, do something to effect their accomplishment.

The Ottawa Convention

By combining the Annual General Meeting with a professional meeting it is hoped to insure a gathering of engineers greater than any yet held in Canada, although the decision to have the Annual Meeting coincide with the Professional Meeting in Ottawa was not made with that definitely in view. These meetings will however, present an opportunity of meeting fellow engineers and for discussing matters of mutual interest, which is rather unique and of which no doubt, advantage will be taken by every member of *The Institute* who can possibly attend. In the past the younger men have felt that they were not particularly encouraged at these meetings and it is earnestly hoped that they will be there in larger numbers prepared to take an active part in addition to getting acquainted with the older men in the profession.

Inasmuch as in all likelihood Parliament will be in session at the time of the Ottawa meeting, February 11th, 12th and 13th, it follows that the hotel accommodation will be limited and therefore it is urged by the Executive of the Ottawa Branch that all who are planning to be in Ottawa at that time should write or wire direct to the hotel at which they wish to stay to secure their own reservations.

As a matter of information hotel rates are given herewith:—

Chateau Laurier, European plan, single room without bath, $2.50 per day; with bath, $3.50 and $4.00 per day, double room with bath, $5.00 per day; Alexandra Hotel, American plan, single room without bath, $3.50 per day, with bath, $4.00 per day; Windsor Hotel, American plan, single room without bath, $3.00 and $3.50 per day, with bath, $4.00 per day; Russell House, European plan, rooms without bath, $1.50 and $2.00 per day, with bath, $2.50 per day; American Plan, rooms without bath, but including meals, $4.00 per day, with bath and including meals, $5.00 per day.

Remembering the Men Overseas

On another column is reproduced the card which was enclosed with nearly five hundred parcels of cigarettes which we sent to our men at the front so that they would receive them before Christmas.

Since these were sent, the whole war situation has changed and we rejoice with our men that in all likelihood a large majority of them will be with us once more before many months have passed.

Those who have not yet contributed to the fund may do so, since to avoid delay the parcels were ordered before the amount needed had been subscribed.

An Important Advantage

It is an unusual pleasure to announce that in addition to the splendid service available to our members through the engineering index, Dr. Harrison W. Craver, Director of the Engineering Societies Library, has graciously intimated to the Secretary that in relation to the use of the Engineering Library, consisting of 120,000 volumes, the members of *The Engineering Institute of Canada* would be accorded the same privilege as the members of the societies in the United States, who have joined forces and placed their libraries in one, in order that it may be of the greatest possible value.

The service of the Engineering Societies Library includes being able to secure complete copies of any magazine article, referred to in the Engineering Index, translation of foreign articles which would help in one's work, a list of references to books and articles on any technical subject. The service bureau of the Library is composed of specialists in engineering literature and is devoted exclusively to such work. The charge for personal work is merely its cost, as the Library does not obtain any profit, but does so to make the information contained in the collection of use to every engineer. This service has proven very valuable and is constantly used by many. The rates for the service are as follows:— Photoprint copies of print, drawings, etc., $0.25 per 10 × 14 inch sheet. Searches, abstracting, etc., $1.50 an hour. Translations, $3.50 per thousand words for French or German, $4.50 and upwards per thousand words for other languages. Reference card service, giving references to current magazine articles, $10 a year, in advance.

Every member of *The Institute* will have a deep sense of appreciation of the courtesy that has thus been granted, for in this we are receiving an advantage far beyond what we could have expected or to which we are in any way entitled.

The Bon Entente

At noon, on the historic Monday, November the eleventh, a gathering of interest to the engineering profession took place, when seven men met at luncheon at the Engineers' Club, in New York, as guests of Calvin W. Rice, who is distinguished for his generous impulses as well as his outstanding ability, in order to give the Secretary of this *Institute* an opportunity of meeting the Secretaries of our sister societies in the United States. There were present at this happy function, held under such auspicious circumstances, Calvin W. Rice, Secretary of the American Society of Mechanical Engineers, Dr. Chas. Warren Hunt, Secretary of the American Society of Civil Engineers, F. L. Hutchison, Secretary of the American Institute of Electrical Engineers, Bradley Stoughton, Secretary of the American Institute of Mining Engineers, Alfred W. Flinn, Secretary of the United Engineering Council, Dr. Harrison W. Craver, Director of the Engineering Societies Library, E. N. Layfield, formerly Secretary of the Western Society of Engineers and the Secretary of this Institute. This luncheon was the occasion of a general discussion of engineering society affairs and also of the relations of *The Engineering Institute of Canada* with the societies in the United States. It was inspiring as well as gratifying to note the genuine spirit of friendship which

exists towards our organization and the desire for the closest possible co-operation in connection with the welfare of the profession.

The engineering Secretaries in the United States are a splendid group of men, earnest, sincere, and capable, and deserving of the kindliest possible feelings to reciprocate their friendly attitude towards us. The question came up regarding making the United Engineering Council international and including in its membership *The Engineering Institute of Canada* and without exception it was agreed that this *Institute* would receive the right hand of fellowship in being welcomed to membership in the United Engineering Council. The success which the engineering bodies in the United States have achieved is an indication of the possibilities which lie before us in Canada in an organization in which we have united the various engineers of different branches. Whatever may be the result of our efforts in the interest of the engineering profession it is evident that we shall have the hearty good will and co-operation of the strong engineering bodies in the United States.

A Wrong Impression

In the November issue of the *Journal* on page 333, was given a brief summary of the work being done at McGill and Toronto Universities, in connection with vocational training for returned soldiers. On the same page was published a photograph of Professor H. E. T. Haultain, M.E.I.C.,Vocational Officer for the Province of Ontario, in charge of the Vocational Branch of the Invalided Soldiers' Commission of the Department of Soldiers' Civil Re-establishment, which gave the impression that the published text on Vocational Training was written by him. In order to correct any wrong impression which may have been created it may be stated that Professor Haultain neither wrote nor inspired the article published.

Broad Reconstruction Policy Needed

In an address by Senator Gideon Robertson, Minister of Labour, at a combined meeting of the Great War Veterans and the Peoples Forum, on Saturday evening Nov. 23rd, at Ottawa, he pointed out the efforts being made by the Government to avoid a post-war panic due to the labour situation which might arise in releasing so many men and women from employment in the munition industries. It is quite apparent from reading the reported account of Senator Robertson's address that the Canadian Government has not, up to the present moment, laid down any broad policy of reconstruction, nor has it arrived at any definite conclusion which will lead to immediate action on the part of the Government to ensure employment for the workers in Canada and for the men on their return from the front. It has scarcely been recognized that the state owes employment to the citizen who is willing to work and until we face the problem from that viewpoint there will be no solution. The establishment of a branch of the Imperial Ministry of Munitions in Canada was the industrial salvation of this country and was the basis of our prosperity during the past few years. In England a Ministry of Reconstruction has been organized and it is certain that unless Canada does likewise we are sure to have adverse industrial conditions.

With the unprecedented requirements to rehabilitate France and Belgium will be needed many of the materials and much of the equipment which Canada can produce. Orders for these could be secured and allocated after the same manner as were munition orders and its seems lamentable in view of the present need of these countries that steps have not already been taken to bring this condition into effect. It is an immediate pressing need, action regarding which is going to decide the demoralization or prosperity of our industrial life.

Australia's Problems Similar

A cursory examination of Engineering Journals from Australia indicate that precisely similar problems are confronting the engineering profession in our sister Commonwealth as have and are still occupying the attention of engineers in Canada.

A Provisional Council representing several engineering Societies of Australia met recently in Sydney to prepare a draft constitution including all branches of the profession. This draft has been prepared and is now before the various societies who report back to the Provisional Council resident in Sydney after which the Council will prepare a final draft constitution for formal submission to all the associations and societies concerned. If the movement for amalgamation is successfully consummated there will ultimately be a National Engineering Institute in Australia similar to *The Engineering Institute of Canada* and comprising all branches of the engineering profession.

The Australia Town Planners' Association held its second annual conference in Brisbane the first week of August. Five hundred and forty-two delegates attended from all parts of the Commonwealth and New Zealand. The Governor General and State Governor were among those present. A responsible Minister of the Federal Government presided.

In South Australia town planning has been made a permanent Department of State. The movement is now under way to have a similar step taken in the other states of the Commonwealth. In Australia the town planning movement is fostered very largely by the engineering profession which accounts for the very satisfactory results already achieved.

In the movement for fostering Industrial Research which has led to the establishment of a Commonwealth of Science and Industry, Australian engineers are taking a very active interest.

Manitoba Branch

The sympathy of the members of the Manitoba Branch as well as of his many friends in the *Institute* throughout Canada, goes out to Geo. L. Guy, Secretary-Treasurer of the Manitoba Branch on account of the death of Mrs. Guy, which occurred on Friday, November 22nd.

REPORT OF COUNCIL MEETING

The regular monthly meeting of the Council was held at headquarters, on Tuesday, November 26th, at 8.15 p.m.

The minutes of the previous meeting having been confirmed, the report of the Executive Committee was presented.

General Specification for Steel Highway Bridges: The action of the Executive in instructing the Secretary to have the suggested Specification for Steel Highway Bridges, submitted by the Chairman, P. B. Motley, M.E.I.C., set in type for the next issue of the *Journal*, subject to the approval of the Council, was ratified.

Town Planning Board Meeting: The appointment of G. G. Gale, M.E.I.C., and J. B. Challies, M.E.I.C., to attend and report the meeting of the Town Planning Board held in Ottawa, on Friday, November 15th, was confirmed and their report submitted to Council as follows:—

Memorandum Re Town Planning.

On Friday the 15th inst. J. B. Challies and G. G. Gale, at the request of the President of the E. I. C., attended a meeting called by representatives of the Dominion Land Surveyors and Architectural Association and others, for the purpose of considering the formation of a Town Planning Institute.

Thomas Adams was appointed chairman of the meeting and the Secretary read the proceedings up to date. The Chairman suggested that the discussion might be carried on under three headings. (1) The necessity for town planners. (2) The desirability of forming a Town Planning Institute. (3) The method to be adopted in carrying this out. Dealing with the necessity for town planners, Thomas Adams cited the example of the recent Town Planning work undertaken by the Riordon Co. A prominent town planner from the U. S. was about to be engaged, but later Mr. Adams with a desire to keep the work in Canada took charge of the work himself, and he engaged Canadian architects, engineers and surveyors to carry out his plans.

Dr. DeVille pointed out that the cessation of war and the re-establishment plans of the Government would result in a large increase in the population of Canada with the consequent necessity for housing and town planning. Men qualified to act as town planners should be located throughout the country ready to undertake this work. One of the architects stated that the immediate future presented great possibilities for those who would be in a position to receive appointments on town planning work. James White also said a few words regarding the need of town planners in Canada.

The second item of the agenda was then taken up and Mr. Adams opened the discussion upon this feature by referring to the town planning institutes of England and the United States, their personnel and constitution. Replying to an inquiry regarding the work of these institutions he stated that The Institute in England had been formed in 1914, and that owing to the war its works had been restricted, but that additional members were coming in all the time. The American Institute was originally formed by landscape architects but that some engineers and surveyors were now becoming members. Mr. Adams felt that the formation of an institute was most desirable. A body of this kind would immediately form a nucleus of town planners, and these members could then draw up a curriculum, arrange a course of studies, hold examinations for entrance, issue diplomas, and finally make a closed corporation of the profession of town planning.

The representatives of the surveyors and architects concurred.

Mr. Gale stated that the whole proposition was new to him, and that further consideration of the matter would be necessary before it was possible for him to say whether in his opinion an institute should or should not be formed. He had attended the meeting to gather information, and did not wish to take an official part in the proceedings. Extensive developments would no doubt take place in Canada, and the town planning should be carried out by properly qualified Canadians. A course in Town planning should be provided either by the proposed institute or by the educational facilities already organized — the universities, colleges and schools throughout the Dominion. Action on the part of the educational authorities might be obtained by representation from the proposed Institute, or by a committee formed of delegates from the Institutions of Surveying, Architecture and Engineering. This latter committee would of course be backed up by the organized and powerful institutes which the members represented, and it should have considerable weight with those who were responsible for educational matters. Mr. Challies concurred.

The others present felt that it was desirable that an institute should be formed immediately. The third item of the agenda was then considered.

It was moved, seconded and carried (Messrs Challies and Gale not voting), that a committee composed of surveyors, architects and engineers should be appointed to investigate and report upon the formation of, and the course of study to be adopted by the *Town Planning Institute.*

The appointment of a committee composed of the following was carried upon motion of Mr. White, duly seconded (Messrs Gale & Challies not voting). Thomas Adams, Chairman, Dr. DeVille, Mr. Henderson, Secretary, Messrs. Cauchon & Challies and two architects.

The meeting then adjourned.

After reading this report it was resolved that the interests of town planning would be most effectively served by the co-operation of the architects, surveyors and engineers in Canada through their organizations appointing representatives for the purpose of securing the most advantageous results.

Institution of Electrical Engineers: A letter prepared by the President in response to one received from the secretary of the Institution of Electrical Engineers, London, Eng., in which the suggestion was made that the members of the Institution, totalling 81, form the nucleus of an electrical section in Canada, was approved as follows:

P. F. Rowell, Esq.,
Secretary,

The Institution of Electrical Engineers,
1 Albemarle Street, London, W. 1, Eng.

Dear Sir:—

I am in receipt of your letter of October 11th and submitted it to our Council for their consideration.

We should certainly welcome the co-operation of members of The Institution of Electrical Engineers resident in Canada, but cannot at present see how they could constitute the electrical section in our Institute. Our organization does not actually provide for an electrical section. It provides for the establishment of electrical sections at our various branches and, in accordance with this arrangement, a number of our branches have already established electrical sections.

Your members could render us and the engineering professions a real service by joining our branches as branch affiliates, which only entails a nominal fee and would enable them to take an active part in the work of the branches or of the electrical sections of the branches, whichever they desired.

We should also be glad to welcome your members as members of our Institute. We have for some time past carried out an unwritten rule that members of the Institution of Civil Engineers in any grade would be admitted to a corresponding grade in our *Institute* upon application. You can appreciate that as we have by-laws

regulating the admission of members of various grades, we cannot commit ourselves to a definite statement that this is our regular practice, but we should be very pleased to extend the same arrangement to members of your Institution, and I feel safe in saying that your endorsement will be sufficient to ensure their admission if they are willing to join us in our work. Generally speaking, we shall be only too happy to receive the co-operation and assistance of your members resident in Canada and will be glad to do anything we can to make them welcome.

Yours very truly,

H. H. VAUGHAN, President.

Statutory Privileges for the Journal: A letter received from the Post Office Department with reference to statutory privileges for the *Journal* was noted in connection with the suggested changes in the by-laws.

Offer of Moving Picture Film: A communication from the Ford Motor Company in which the offer of a moving picture film, entitled Coal is King was made, was presented and the secretary instructed to communicate this offer to the various branches for any action they might wish to take and to write the Ford Motor Company, thanking them for their courtesy.

Remuneration of Technical Men: The question of the salaries being offered for technical men by the Civil Service Commission of Canada was discussed. It was agreed that the Commission has heretofore not in any way appreciated the value of technical men, nor adequately considered the remuneration that should be offered. The secretary was consequently instructed to write the Honourable W. J. Roche, Chairman of the Commission, and William Foran, Secretary, a letter pointing this out.

The Honorable W. J. Roche,
Chairman, Civil Service Commission of Canada,
Ottawa, Ont.

Dear Sir:—

In your Bulletin of November 14th we note with considerable satisfaction that for two of the positions mentioned therein you require men who have had university training in science and that they shall have attained professional standing whereby they have gained admission to one of the three named engineering organizations.

A survey of the technical positions open from time to time in your announcements indicate that in allocating salaries, your Commission has not taken into consideration the additional monetary value which should be placed upon the services of the highly educated and trained technical man.

For numbers two and three on the Bulletin mentioned you offer $1,600 salary. One, the highly professional man and the other, a clerk with a good general education. This is only one instance which illustrates that in all fairness the Civil Service Commissioners of Canada should place about 100% higher value on the services of technically trained men than they have been doing in the past. We feel most strongly that the situation requires remedying, and are also willing to believe that now that it has been called to your attention in an official manner, you will give this the serious consideration it deserves.

On behalf of the Council of

The Engineering Instiiute of Canada.

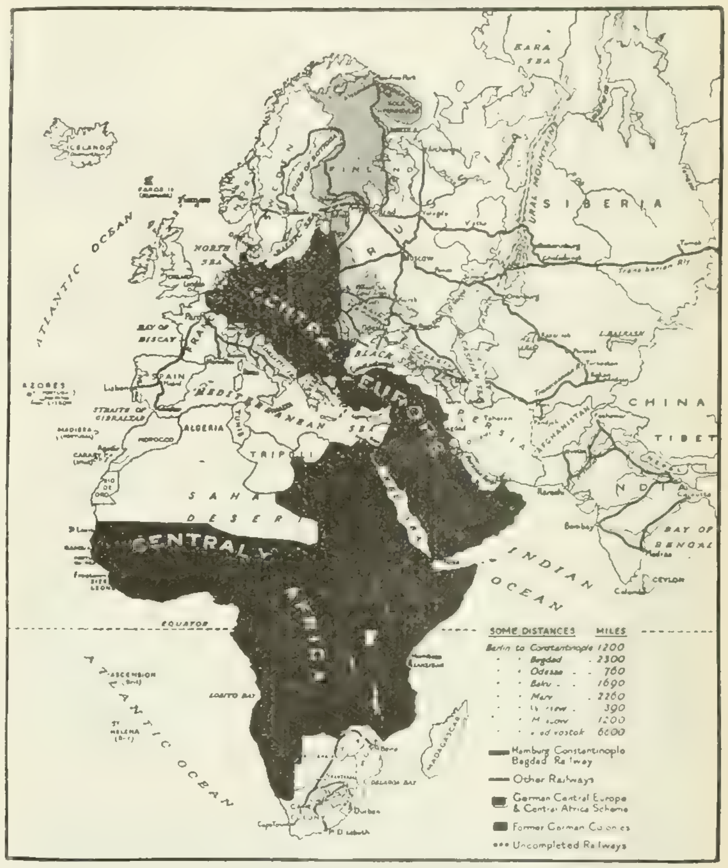
Yours very truly,

FRASER S. KEITH, Secretary.

Assistance to Government Engineers: The suggestion was considered from one of our members that Council appoint a strong committee with a view to bringing in a recommendation for proportionate representation to the government to the end that the Civil Service Commission, which is charged with the responsibility of classifying employees, should comprise an engineer in some capacity in order that the commission might more intelligently apportion salaries of engineers in the Government employ. This suggestion was approved and the appointment of a committee left with the President.

Map of German Plot: Two copies of a map headed, "The Great German Plot" showing the territory that was coveted by Germany before the war and containing an account of Germany's ambition were received from H. E. M. Kensit, M.E.I.C., London, Eng. The secretary was instructed to write thanking Mr. Kensit and also to have this map framed, in the meantime publishing it and the article thereon in the *Journal:*

THE GREAT GERMAN PLOT



MITTEL-EUROPA AND MITTEL-AFRIKA AS THE GERMANS PLANNED THEM

Points to Remember: By the Earl of Denbigh

1. Frederick the Great, the Kaiser's Ancestor, of whom he is so proud, was the maker of Modern Prussia, and wrote thus to his Minister Podewils: "If there is anything to be gained by being honest men, we will be honest, and if it is necessary to dupe, let us be rogues." Those maxims have been the keynote of German policy ever since.

2. Modern Germany believed in aggressive militarism and has seen how wars could be made short and successful when waged on the Prussian system of always being ready themselves and then falling on an unsuspecting enemy and treating the civilian population with ruthless brutality. Germany has grown rich and strong by the success of the three short wars of 1864, 1866 and 1870 against Denmark, Austria, and France respectively. Germans have found that war could be made a paying business, and they expected a short and successful war when they suddenly fell on an unready world in 1914.

3. Since 1870 the Prussian spirit of arrogance, ambition, cunning and ruthlessness has gradually permeated through Germany. Germans have more and more aimed at World Dominion. "Weltmacht oder Niedergang" ("World Dominion or Downfall") became a favourite motto. "World Dominion" by an arrogant, ruthless, faithless race of bullies like the Germans would mean the downfall of every other nation. America especially has realised that.

4. Years ago Germany began her "Peaceful Penetration" of other nations by commerce, and infiltration of Germans; but if this failed to give her World Dominion she was preparing all the time to fight for it. As German commerce increased Britian was found to be in the way of Germany. The British Fleet and Union Jack in foreign fortified coaling stations constituted the chief world protection against German "Weltmacht." Britain, they saw, must be defeated in war, or Germany must be quietly manœuvred into a position of strength where she would be irresistible.

5. Modern Germans looked on theirs as a heaven sent nation destined to rule the world, and said the British were an effete, decadent, played-out nation of shopkeepers unworthy to own an Empire.

6. Germans saw that "the most vital nerve-centre of the British Empire is Egypt and the Suez Canal," and with this route to the East in the hands of Germany, and all Indian reinforcements only able to use that route by, and with, the leave of Germany, the British-Empire would be cut in two and receive its death-blow. German writers said, "At Suez we can stab England in the heart and kill her." A stranglehold would be obtained on the whole of Europe if all the great Eastern trade from the Mediterranean had to pass through a German-controlled canal.

7. Twenty years ago Germany began to educate her people on the advantages that a "Mittel-Europa," or Central Europe, would give them, if Austria, Rumania, Serbia, Bulgaria, Greece and Turkey to the Persian Gulf were all controlled from Berlin. So the Bagdad railway from Constantinople to Basra was begun — a great German trunk line from Hamburg, 3,000 miles long. The population of this territory separating East from West would be 170 millions, and from the Aleppo district, Germany could threaten Egypt and India via the Persian Gulf or through Persia.

8. Germany's persistent attempts to seize positions for controlling the main trade routes should be noted. In 1905, Turkey, prompted by Germany, tried to alter the Egyptian frontier so as to make Akaba a strongly fortified naval base for controlling the Suez Canal traffic. This base would have a direct line to Germany over the Hedjaz railway. About the same time Germans seized, and hoisted their flag on, an island near the entrance to the Persian Gulf. If the owner, an Arab Chief, had not ejected them, with this island fortified, and a naval base at Basra, the Gulf, on the flank of our route to India, would soon have been a German stronghold. The same year they threatened Portugal with a view to getting a coaling station at Madeira, and Portugal appealed to England for protection, whereon the threat was abandoned. American strongly disapproved of the idea of Germany getting a footing in Madeira on her direct route to the Mediterranean. In 1911 Germany seized the fine harbour at Agadir; but France, Spain and Britain forced her to leave.

9. Soon after this, Germany began to prepare for war in 1914, when the Kiel Canal enlargement would be completed. Serbia had to be crushed to clear the road to the East, so in June 1914, the Archduke of Austria was murdered "under mysterious circumstances," which Germany could probably elucidate. When it was seen Serbia could not be crushed without fighting, the Germans, already secretly mobilised, rushed at France through Belgium, hoping to overwhelm her, and then join Austria in defeating Russia and Serbia. Britain was expected to stand out and could be dealt with later, as openly admitted by German writers. Britain, by coming in, spoilt the German plans for a short war; hence a bitter hatred of us and a brutal spite vented on British prisoners.

10. Through the collapse of Russia, Germany obtained great mineral and corn districts and complete control over the Baltic Sea and the Black Sea; and, when the canals connecting the Danube with the North Sea were completed, it would be possible to bring submarines right right across Europe to the Black Sea.

11. [illegible] *in the East.* By submarines from the Adriatic, Black Sea and Smyrna, she wanted to make the Eastern Mediterranean impassable, and an attack through Palestine on Egypt irresistible.

12. Egypt taken, the cotton would be diverted to Germany, and the whole of tropical Africa made into a "Mittel-Afrika," according to the further German scheme. (The map overleaf is from a German map.) From four submarine stations — at Emden in the North Sea, the Cameroons (W. Africa), German East Africa and German New Guinea (N. of Australia) — every important trade route in the world could be reached.

13. The Allies and America realise there can be no peace or liberty if the world is dominated by a nation which only believes in the doctrine that "might is right."

Invitation from A.S.M.E.: The courteous invitation from Calvin W. Rice, Secretary of the American Society of Mechanical Engineers to the Council and members of standing committees of *The Institute* to attend their annual meeting on December 3-6, was read and the Secretary was instructed to write Mr. Rice, thanking him most heartily for the kind invitation extended. President Vaughan intimated that he was planning to be present.

Grand River Conservation: A communication from W. H. Breithaupt, M.E.I.C., of Kitchener, Ont., in reference to a paper by him on The Grand River Conservation, was presented. The Secretary was instructed to publish the paper in the *Journal.*

Ontario Provincial Division: Nominations of the Toronto Branch, containing non-resident representatives on the Ontario Provincial Division were received and approved.

Legislation: A letter from the Secretary of the Manitoba Branch, suggesting certain procedure regarding the final adoption of a provincial act was read and the Secretary was instructed to communicate the following letter to the Manitoba Branch:

Geo. L. Guy, Esq., M.E.I.C.,
Secretary Manitoba Branch,
300 Tribune Building,
Winnipeg, Man.

Dear Sir:—

Since receipt of your letter of October 30th you will have received the draft Act published in the November issue of *The Journal* which was issued with the view to a complete discussion by each branch. You will note that, while a general discussion is called, it is intended that the official opinion of each branch be considered and it would therefore be now in order for your committee to consider the draft published and make recommendation thereon to your branch to be forwarded to Council. It is hoped that this procedure will be followed by each branch and considered at the earliest possible moment, together with any general discussion which may come in from non-resident members.

This should not delay the matter and would undoubtedly enable Council to give an intelligent decision regarding an Act that would be suitable for all Branches.

Yours very truly,

FRASER S. KEITH,
Secretary.

Nova Scotia Society Members: A letter from the Chairman of the Halifax branch, with reference to applications of men who had been members of the Nova Scotia Society of Civil Engineers, was read and referred back to the Executive, with power to take action thereon.

Changes in By-Laws: The final report of the committee appointed by Council to draft the suggested changes in the by-laws was presented and approved. These changes are being published in this issue in another column and this will constitute the official notice of the proposed changes which is required to be sent to all corporate members not less than twenty-one days before the Annual General Meeting.

Recommendation of the Toronto Branch: A suggestion of the Toronto Branch executive regarding having Council take action in memorializing the government in connection with taking immediate action for ensuring employment of labor, the development of municipalities and the improvement of transportation facilities, was considered and referred to the Executive Committee for action.

Resolution of Felicitation: In view of the universal satisfaction which the signing of the armistice terms has afforded and of the part that the engineering profession must play in rehabilitating the war-wasted areas, it was decided that a resolution of felicitation be sent by the Council to the four founder engineering societies in the United States and to the Institution of Civil Engineers of Great Britain.

December Meeting of Council: In view of the fact that in following out the regular practice, the December meeting of Council would come on Christmas Eve, it was decided that the regular meeting for December would be held on the 17th.

Maritime Professional Meeting: The Secretary was instructed to write the St. John Branch, asking for endorsation of the branch of the invitation received from the Mayor and Chairman of the Board of Trade to hold the next Maritime Professional meeting in St. John, in order that Council might give a definite decision without further delay.

Leonard Medal: A committee to consider the awarding of the Leonard Medal for the current year was appointed, consisting of, Lieut.-Col. R. W. Leonard. Dr. J. B. Porter, Professor H. E. T. Haultain, G. H. Duggan, D. H. McDougal and John C. Gwillim.

Plummer Medal: A committee to consider the awarding of the Plummer Medal for the current year was appointed, consisting of Dr. A. Stansfield, B. F. Haanel and J. A. DeCew.

Ballot for the Election of Officers: The Secretary requested instructions regarding the issuance of a ballot for the election of officers, since the procedure was somewhat different this year, owing to the fact that the various councillors would be elected by their own districts. It was decided that a ballot similar to those of other years would be issued, but giving information in heavy type as to the procedure to be followed,— that in voting for councillors no member should vote for any councillor not resident in his own district.

Library Privileges: The Secretary was instructed to write expressing the Council's hearty thanks to Dr. Harrison W. Craver, Director of the Engineering Societies Library, for his courtesy in placing at the disposal of members of *The Engineering Institute of Canada* the services of the Engineering Societies Library, placing our members in this connection on the same basis as the members of the founder societies of the United States.

Annual General Meeting: It was decided that the Annual Meeting should be called for January 28th at the headquarters of *The Institute*, at which time the auditors would be appointed and the scrutineers named to canvas the ballot for the election of officers and councillors, it being intended that the result of the ballot be handed to the Secretary in a sealed envelope, to be opened in Ottawa. It was resolved that the Annual Meeting be postponed to meet in Ottawa, on February 11th, at the Chateau Laurier, the programme for which would be announced later.

Invitations to Annual Meeting: It was proposed and heartily endorsed, that a cordial invitation to attend the Annual Meeting be sent to the Chairman and Secretary of the United Engineering Council; the President and Secretary of the American Society of Civil Engineers; the President and Secretary of the American Society of Mechanical Engineers; the President and Secretary of the American Institute of Electrical Engineers and the American Institute of Mining Engineers and to the President and Secretary of the Canadian Mining Institute.

Programme of Ottawa Meeting: The minutes of two meetings of the Professional Meeting Committee of the Ottawa Branch were presented to Council. This committee consists of G. G. Gale, Lieut.-Col. C. N. Monsarrat, A. St. Laurent, R. F. Uniacke, J. B. Challies, Noel Ogilvie, R. de B. Corriveau, A. B. Lambe, A. A. Dion, G. B. Dodge, John Murphy, A. F. Macallum, A. V. Gale, Lieut. J. A. Walker. The committee was given charge of all arrangements in connection with the professional meeting to be held in Ottawa, immediately after the business of the Annual General Meeting. Lieut.-Col. C. N. Monsarrat was elected chairman and G. B. Dodge secretary.

It was decided at the first meeting that the most desirable method of organization for the meeting would be to divide the work among four committees, as follows;—Reception and Rooms Committee; Entertainment Committee; Programme and Papers Committee; Finance and Publicity Committee; each committee to consist of three members, with power to add to its numbers. A committee was appointed to select the personnel of these committees.

It was decided to ask the Secretary of *The Institute* to attend the second meeting and arrangements were made for a meeting on Saturday, the 25th inst., at eight o'clock, p.m., which was attended by every member of the committee and the Secretary. At this meeting the programme for the professional meeting was discussed tentatively, the opinion of Council being requested regarding the probable duration of the business course of the meeting. The committees appointed were as follows:

Reception and Rooms Committee: A. St. Laurent, convenor, G. G. Gale, J. Murphy, A. B. Lambe, C. R. Coutlee and the secretaries of the various branches; Programme and Papers Committee, A. A. Dion, convenor, R. de B, Corriveau, G. G. Gale, J. B. Challies; Entertainment Committee: J. Murphy, convenor, A. V. Gale, J. B. Challies, J. A. Walker; Finance and Publicity Committee, A. B. Macallum, Noel Ogilvie, R. F. Uniacke, A. B. Lambe; Lieut.-Col. C. N. Monsarrat and G. B. Dodge, the Chairman and the Secretary of the committee, to be ex-officio members of all the sub-committees.

It was further decided in connection with the programme to ask the Toronto and Hamilton branches for suggestions. The Secretary was asked to request the Council to extend invitations to the officers of the United Engineering Council and to the other engineering societies.

It was decided that in view of the hotel accommodation in Ottawa being limited and that in all likelihood Harliament would be in session at the time of the professional meeting, it would be necessary for those coming from out of town to secure their reservations from the hotels and to do so as soon possible.

Council expressed hearty approval of the activity of the Ottawa branch in connection with the professional meeting. It was considered that the business of the meeting would be completed in the morning and afternoon

sessions, the President's address to ge given at four o'clock in the afternoon of the first day.

Classifications: Classifications for a ballot returnable December 17th were made.

Ballot: A ballot was canvassed and the following elections and transfers effected:—

Member

John Wilson Roland, of Halifax, N.S., since 1911, chief engineer for Foley Bros., Welch, Stewart & Faquier, contractors for Halifax Ocean Terminals, now in private practice.

Associate Members

Albert Johnson Barnes, of Halifax, since 1911, superintendent of traffic, Maritime Telegraph & Telephone Company, Halifax; George Ernest Booker, Halifax, member of firm, Booker & McKechnie, Halifax; Andrew Joseph Boyle, of Edmonton, Alta., assistant engineer for the Department of Railways & Canals, in charge of locating parties; Kenneth Gordon Chisholm, of Halifax, since 1913, assistant engineer for the Dominion Water Powers Branch, with the exception of two years with the allied armies; Keith Pruyn Johnston, of Saskatoon, Sask., since 1915, lecturer in mathematics in the Faculty of Applied Science, Queen's University, and during the summers of 1917-18, engineer with Murphy & Underwood, Saskatoon, Sask., on general engineering work. Lieut. Edward Sherburn Kent, in civil life, manager of western branch of the Canadian Inspection & Testing Laboratories Co., Ltd., but since 1916, a lieutenant with the Royal Engineers in Italy; Charles Burfoot Leaver, of Dartmouth, N.S., since 1915, assistant superintendent of the Dartmouth Refinery, in charge of construction and operation; Seaforth Duff MacNab, of Montreal, connected with McGill University since 1894 and since 1908 has been engineer in charge of strength of Materials & Hydraulic Laboratories; John Jeremiah McDougall, of Bell Island, Nfld., with the Dominion Iron & Steel Co., since 1906 and manager from 1914; John S. Misener, of Dartmouth, N.S., with the Acadia Sugar Refining Co., for twenty years and at the present time its chief engineer and assistant manager; John Russell Montague, of Montreal, designer and resident engineer for A. R. Henry; Joseph Rocchetti, of Winnipeg, Man., with the Public Works Dept., Manitoba government, as designing engineer and asst. to the provincial electrical engineer since 1916; Hector de la Grange Warren, of Pointe-au-Pic, with the Public Works Dept. since 1913, at the present time in charge of proposed waterworks system for Pointe-au-Pic.

Junior

Charles McCawley Bowman, of Halifax, since 1914, sergeant and machinist electrician, of the 10th (Fortress) company, Canadian Engineers.

Associate

Thomas Carmichael, of Moose Jaw, Sask., since 1917, superintendent Works branch, Military Hospitals Commission, Regina.

Transferred from Associate Member to Member

Purcell Eli Doncaster, of New Westminster, B.C. Served in France since 1915 as officer with the Canadian Expeditionary Forces; returned in 1918 and resumed duties as chief assistant, to the district engineer, New Westminster.

Transferred from Student to Associate Member

Huet Massue, of Montreal, with the Quebec Streams Commission since his graduation in 1913.

Transferred from Student to Junior

William Whitaker King, of St. Johns, Que., at the present time, lieut., with the Canadian Engineers at St. Johns. Before enlisting he was with the Toronto & Hamilton Highway.

Asphalt Survey

According to a survey just complete, under the direction of J. D. Northrop of the United States Geological Survey, the demand for native bitumens and various types of bituminous rocks produced in the United States, has decreased by the stimulated activity in the demand for asphaltic materials from crude petroleum and for imported asphalt.

The native bitumen, including maltha, gilsonite, elaterite and grahamite, bituminous rock, and ozokerite, marketed from mines and quarries in the United States in 1917 was 80,904 short tons, a loss of 17,573 tons, or 18 per cent., compared with 1916. The market value of the output in 1917 was $735,924, a loss of $187,357, or 20 per cent., compared with 1916.

The production of gilsonite, bituminous sandstone, bituminous (elaterite) shale, and ozokerite was increased considerably in 1917, but the gain credited to these varieties was insufficient to offset the loss in the production of elaterite, grahamite and bituminous limestone.

The quantity of manufactured asphalt (including road oils and flux) produced in 1917 from petroleum of domestic origin increased about 2 per cent., compared with 1916, and the quantity of corresponding material manufactured in this country from Mexican petroleum increased about 13 per cent., as a consequence of which the net gain over the production in 1916 was nearly 7 per cent.

The total sales in 1917 of manufactured asphalt derived from domestic petroleum amounted to 701,809 short tons, valued at $7,734,691. This total includes 327,142 tons, valued at $4,011,980, of solid and semi-solid products used in the paving and roofing industries and 374,667 tons, valued at $3,722,711, of liquid products, including road oils, flux, and asphaltic paints.

California maintained its supremacy in the production of oil asphalt. Its output from fourteen petroleum refineries in 1917 aggregated 220,294 tons, valued at $2,100,252, and included 135,160 tons of solid and semi-solid products, valued at $1,486,609, and 85,134 tons of liquid products, valued at $613,643. Refiners handling oil from the Oklahoma-Kansas field produced 206,223 tons of oil asphalt, valued at $1,975,493, including 73,410 tons of solid and semi-solid products, valued at $747,651, and 132,813 tons of liquid products, valued at $1,227,842.

The total sales in 1917 of manufactured asphalt derived from Mexican petroleum amounted to 645,613 short tons, valued at $7,441,813, and included 338,485 tons of solid and semi-solid products, valued at $4,657,152.

BRANCH NEWS

Vancouver Branch

A. G. Dalzell, A.M.E.I.C., Secy.-Treas.

To Members of the Vancouver Branch.

The following communication has been received from the Secretary of the *Institute:*

"At a meeting of Council held on the 22nd inst. it was decided to publish a draft Act on legislation in the *Journal*, with a view to inviting discussion, and I am instructed to advise you that Council requests the Branches, and the members of Branches who desire to do so individually, to write to the *Journal* discussing legislation; also that all discussion on the subject be carried on among the Branches and through the *Journal*."

The Vancouver Branch at a meeting held on October 9th, adopted resolutions which have been forwarded to Montreal and to the Secretaries of all Branches. For the sake of members who were unable to be present at that meeting the resolutions may be thus briefly summarised:

1. Approved of movement to secure some legislation to register engineers.

2. Suggested that the movement be limited at the beginning to the registration of engineers who undertake public work.

3. Approved of the principle of associating members of the University staff on the board of examination.

4. Established the principle that registration in one Province should qualify for any Province, provided Provincial fees are paid.

5. Suggested that a Commission composed of
 One Member of the Provincial Cabinet,
 One Member of the University Engineering Staff,
 One Member of the *Engineering Institute*,
should determine the minimum rate of pay to be paid to Engineers.

At the same meeting it was decided that as the funds of the Branch did not permit of a subscription to the Tobacco Fund for members overseas, that a subscription should be asked from members individually, a dollar subscription was suggested. Notwithstanding the intimation given in the *Journal*, no subscriptions or promises have been received by the Branch Secretary. On receipt of this notice please mail a postal card to the Secretary as an I.O.U. It is the least we can do to acknowledge what has been done for us. Fifty-three members of the Branch have enlisted and seven have paid the supreme sacrifice.

Members will regret to note the death of Colonel William Mahlon Davis, which took place at Ottawa, and one of the oldest members, Henry Badeley Smith, of Vancouver. Obituary notices will appear in the *Journal*.

Saskatchewan Branch

J. N. deStein, M.E.I.C., Secy.-Treas.

Since making the report for the October number of the *Journal* a special and a regular meeting of our Branch have been held, both meetings practically being devoted exclusively to a discussion of the proposed legislation. Unfortunately, the epidemic outbreak of influenza compelled the executive committee to cancel a special meeting called for the same purpose for October 26th as well as the regular November meeting, so that the urgent discussion of our proposed Act is being held up at present.

There is, however, considerable progress to report, as the draft of the Act has been thoroughly revised and also considerably curtailed. It was felt that a number of points contained in the original Act (as presented at Saskatoon) could well be taken care off in the future by-laws. While the original draft limited its application to engineers undertaking public works, a number of members of our Branch corporation engineers protested very strongly against their omission from the proposed legislation. It was felt therefore that they should be included.

The Vancouver Branch sent us a copy of a circular letter concerning future legislation, containing several decisions arrived at by their members. One of the points suggests: "that it is wise to limit the movement at the beginning to the registration of engineers who undertake public works." We would be very glad to hear further in this matter from other branches or individual members.

A very timely suggestion has been made by the Manitoba Branch. They suggest a thorough discussion of the proposed Act in each one of the Provinces and the appointing of provincial legislative committees. After arriving at a uniform basis of legislation, Manitoba suggests having representatives of each committee meet at some central point to agree upon a final draft. This agreement should take place prior to any individual action by any one province in obtaining legislation. It seemed to be the opinion of the majority of our members to support the suggestion of the Manitoba Branch, instead of hurriedly requesting legislation, which would not meet the conditions in other provinces. There is only one question in the mind of the writer in this connection: Will the proposed meeting of representatives of provincial committees be confined to the Western Provinces or will the Eastern Provinces of our Dominion join in the movement at present?

The draft of the Act, as presented at Saskatoon was not completed. It did not contain any stipulations, who is to take examinations, details of apprenticeship, classification of members etc., etc. The legislative committee of our Branch has been instructed to prepare additional clauses covering these items, which will be presented at the next meeting.

The question arises in this respect, how is admission to be gained to the provincial institutes? Will it merely mean, that every member of the parent institute can by simple application join any provincial institute, or will a short examination be required for every Province, similar to the relations existing between the various provincial

land surveyors associations? Also in the future will the new applicants join provincial or parent institute? In the former instance membership in the Provincial Institute will have to automatically cover membership in the parent Institute. There is a question in our mind if provincial legislation will permit the joining of provincial institutes through admission to a national organization outside altogether of the individual legislation.

These are only a few of the questions arising.

In a circular from the secretary to the members of the Saskatchewan Branch, which contains a number of interesting suggestions, are included the following:—

"It has been decided by our Executive Committee to postpone our regular and special meetings until such time as the present epidemic outbreak of influenza has abated. The undersigned Secretary thought it therefore his duty to bring this fact to the notice of our members.

It is unfortunate that the important discussion of our proposed "Act concering the Engineering Profession in Saskatchewan" is being thereby suspended, but we have been requested by our parent Institute to discuss it at length in our "*Journal.*" The Manitoba Branch suggests a meeting of a Western Legislative Committee representing all branches, in order to finally settle all details of a proposed uniform act. The Edmonton Branch is of the opinion that legislation should be sought this year."

St. John Branch

A. R. Crookshank, M.E.I.C., Secy-Treas.

The St. John Branch held a meeting on Nov. 21st, and discussed the draft of act proposed by the Saskatchewan Branch, as published on Page 331 of the *Journal*, and the editorial, including the decision of the Vancouver Branch on Page 335.

All the items were carefully considered, but the meeting decided that the matter had not been sufficiently discussed, and adjourned to meet later, at which time definite action will be taken. The following points were brought out during the discussion:—

Article 7 — Clause A: General opinion was that this clause should be broken up into two sentences by a full stop placed after "words" in the eighth line, and the possible omission of the last portion, as it was considered that the clause as it stands rendered the act worthless to the engineering profession, as it limited it to Government employed engineers only. The limit of $1,000.00, if applied to both private and public work in most cases would be too low, but there would be important exceptions where public health and safety would be endangered. A limit of $2,000.00 and one of $5,000.00 was suggested. It was agreed that any work that in any way endangered the public health and safety, if defective, should be carried out under a "registered engineer." Also it was agreed that one of the principal objects of the act should be to prevent a man posing as a qualified engineer, when he isn't i.e., to prevent any impostor from practising.

Article 7 — Clause C: It is suggested that this clause be modified to allow of reciprocity between provinces having similar acts, so that a man who registered and paid his registration and annual fees in one province, should not be asked to pay annual fees in other provinces. Also that the registration fees in a second and subsequent provinces, should only cover the cost of such registration, or it might be desirable to have registration without charge.

Article 14 — Clause B: This clause should be modified, as it does not include all branches of engineering in New Brunswick, to read "The candidate shall pass an examination before the Board of Examiners of *The Institute*, on the theory and practice of engineering, and especially in one or more of the recognized branches of the profession, at his option."

The first item of the Vancouver Branch resolutions, shown on page 335 of the *Journal*, was moved and adopted.

Toronto Branch

Geo. Hogarth, M.E.I.C., Secy.-Treas.

A meeting of the Executive Committee of the Toronto Branch was held on Monday, November 4th at 5 p.m.

On discussion it was decided to forward the following opinions to the parent *Institute* at Montreal, and to send a copy of these opinions to the representative of this Branch on the Joint Committee of Technical Organizations. The Secretary was instructed to request Council to take this matter up immediately with the Government.

1. It is our opinion that Government departments, federal and provincial and the administrative authorities of municipalities should be urged to complete their plans for needed public works and to arrange for their approval and financing so that surplus labor on the cessation of hostilities may be usefully employed thereon.

2. In connection with all municipal improvements proper attention should be given to town planning so that towns and cities may grow in a logical manner.

3. As the transportation systems of the country are now so largely in the hands of the Government, plans should be completed for carrying out the necessary needed improvements in connection therewith, so that the work could be put in hand quickly when labor becomes available and in need of employment. Carried.

A resolution from the technical section of the Canadian Pulp and Paper Association, dated September 12th, 1918, was read. This resolution urged on the Federal Government the consideration of technical education.

Moved by Mr. Hewson, seconded by Mr. McCarthy, that this Executive endorse the five resolutions of the technical section of the Canadian Pulp and Paper Association as passed September 12th, 1918. Carried.

The meeting adjourned at 6.50 p.m.

Circular to Branch Members:

In accordance with clause 5 of the by-laws of this Branch, the Secretary will receive nominations by letter on or before November 22nd for the offices of Chairman, Secretary-Treasurer and six Committeemen for the 1919 Executive of the Toronto Branch of this Institute.

Each nomination must be made in writing and signed by at least five corporate members in order to be entertained as a nomination.

PETER GILLESPIE, Chairman.

GEO. HOGARTH, Secretary-Treasurer.

Halifax Branch

K. H. Smith, A.M.E.I.C., Secy.-Treas.

A general meeting of the Halifax Branch of the *Institute* was held in the Board of Trade rooms on the evening of Thursday, November 14th. At this meeting F. A. Bowman, M.E.I.C. Chairman of the Halifax Branch read a paper on the Effect of the Halifax Explosion on the Telephone Plant and Service. Unfortunately, the attendance at the meeting of members of the Branch was not as large as the merit of Mr. Bowman's paper would warrant or as might be expected considering the size of the Branch. No doubt the peace celebrations of the few days previous and the bad weather on the night of the meeting may be considered as extenuating circumstances.

However, an encouraging feature of the meeting was the presence of a number of substantial citizens of Halifax outside of the membership of the Branch and the interesting discussion which followed Mr. Bowman's paper.

For some time after the explosion in Halifax there were many complaints of the telephone service. After hearing Mr. Bowman's paper, one wonders that there was any telephone service at all for a considerable time after the explosion, and it is to be regretted that this paper could not be more widely circulated among the citizens generally.

Ottawa Branch

J. B. Challies, M.E.I.C., Sec.-Treas.

At a meeting of the managing committee of the Ottawa Branch on Wednesday, November 6th, a number of important matters were dealt with. After reading the minutes of the previous meeting the Secretary laid on the table a communication from the general secretary of the *Institute* advising that the suggestion of the Ottawa Branch, that the annual meeting of the *Institute* and the General Professional Meeting for the province of Ontario for 1919, be combined and both held in Ottawa, had been approved by Council. It was decided to form a committee to co-operate with the general secretary and make the necessary arrangements for this combined meeting. It was moved by Mr. Murphy, seconded by Mr. White and resolved, that the selection of this committee be left with the chairman and the secretary. The chairman of the Proceedings Committee, A. F. Macallum, reported that he had arranged for a luncheon meeting for Thursday November 14th, or Friday November 15th, at which Capt. E. A. Baker, M.C. had consented to speak on Vocational Training of Blind Soldiers.

Upon consideration of the question of revising the branch by-laws, Mr. Murphy pointed out that the special committee of the Montreal branch had been engaged for some time in drafting a set of standard branch by-laws. It was considered advisable that the Ottawa branch should be in a position to take action as soon as the report had been obtained from the Montreal branch. On the motion of A. F. Macallum, seconded by James White, it was resolved that a special committee be appointed for this purpose consisting of Messrs. Murphy, Dodge and Corriveau, with the secretary treasurer of the branch. Mr. White made a verbal report with respect to the result of the conference of representatives of professional societies held at the Chateau Laurier some weeks ago at the request of the secretary of the Canadian Mining Institute to consider certain proposals from Mr. Corless concerning education.

The secretary reported that L. R. Thomson, the chairman of the standing committee on publicity, had submitted his resignation, made necessary by his departure from the city. It was resolved that the chairman of the proceedings committee, Mr. Macallum, should act as chairman of the Publicity committee.

There was laid on the table a communication, dated November 6th, from the secretary treasurer of the Association of the Dominion Land Surveyors, requesting that a representative of the Ottawa branch of the *Engineering Institute* be appointed to attend a meeting to be called on November 15th at 4 p.m. of representatives of the Association of Dominion Land Surveyors and of architects to consider ways and means for training town planners. It was moved by Mr. Challies, seconded by Mr. Corriveau, and resolved that Mr. White and Mr. Cauchon be the representatives from the branch to watch proceedings and report back to this committee.

The secretary laid on the table the financial statement of the branch for the period January to August, which was approved. There was laid on the table a communication dated October 29th from the general secretary urging the various branches to make a special effort to interest worthy men to join the *Institute* as associates. This matter was referred to the chairman of the standing committee on Membership, Mr. Corriveau, for consideration and report. The chairman referred to by-law No. 4 of the Branch which specifies the action to be pursued in arranging for nominations for the vacant officerships for the ensuing year. It was resolved that all past chairmen of the Branch should be constituted as a nominating committee under the convenorship of the present chairman of the branch, who is authorized to call a meeting at the earliest convenient date to make arrangements for nominations for the vacant officerships of the managing committee for the calendar year 1919.

CORRESPONDENCE

Diving Bell

Editor, *Journal:—*

I have read with interest, a paper by Mr. J. J. McDonald, on the Diving Bell which was built, and is being used on the construction of the foundations of the dock walls at the new Halifax Ocean Terminals, as published in *The Journal of the Engineering Institute of Canada,* October 1918 issue.

In this paper, Mr. McDonald calls his device a Floating Caisson or Diving Bell, and lays claim to being the originator of this type of apparatus. It is necessary for me to contradict this statement. I have watched with interest the use of this particular machine, and have awaited the publication of an official detailed description of it, which I felt would sooner or later be made public. I have also been aware of the claims made in connection with the device, and have had to allow these claims to pass unchallenged for want of official detailed information. It is impossible for an outsider to get such information unless voluntarily given.

With regard to Mr. McDonald's claim, as to the unique and original features of the Caisson, namely, the convertible buoyancy and ballast chambers, if you will refer to the Engineering News of April 23, 1914, you will find a description of a self contained floating caisson or diving bell, invented and designed in May 1913 by me, and put in operation by me in August 1913 on the construction of the underwater sub-structure of the dock walls at Hamilton, Ontario. This apparatus worked successfully from the first day of its use, and continued in use more or less continuously, for three years at the Hamilton Harbor until the completion of the work in hand.

It is possible, but scarcely probable, that Mr. McDonald and those associated with him were unaware of the existance of the machine in Hamilton, on account of the publicity given to the device and the number of engineers in the construction departments of the Dominion Government, to whose attention the apparatus was brought.

The apparatus in Hamilton, consisted of a working chamber, with buoyancy chambers convertible into water ballast chambers attached to the sides of the chamber, and with an air lock on top. It also carried additional water ballast tanks on top for use when required for additional submersion. The machine depended partly on its own dead weight, and partly on the water ballast contained in the buoyancy or ballast chambers, to give the necessary load to resist the upward thrust of the air compressed in the working chamber. The particular device was perfectly stable under all conditions for which it was intended, the metacentre being well below the centre of gravity under all conditions, whether floating light, or submerged in operation. The machine in use, required very light draft in order to clear the submerged structure which was built in sections, and this result was obtained by placing the main buoyancy chambers along side of the working chamber.

The device was equipped with spuds to serve as anchorages for work near the surface, but were not required to ensure stability. Air was supplied to the working chamber, air tools, etc., from a compressor mounted on a separate scow along side the outfit. It was not necessary on this work to have a long air shaft from the lock to the working chamber, but the device in principle, only required this change, and other structural adaptions for deep water work.

The Halifax machine, when in actual operation, does not float, the buoyancy chambers merely serving the purpose of facilitating its transportation from one part of the work to another. The one used at Hamilton, actually floated at all times.

For some reason, the device brought out by the writer, has escaped the notice of the Canadian technical press, though Engineering News of New York, saw fit to describe it and give it credit for originality.

The writer has arranged with James Stewart & Co. of New York, for the use of his patent and design on the construction of about four miles of sub-structure of the break-water wall to be built by that company at Toronto Harbor, between the western entrance and the mouth of the Humber. This apparatus, as designed, will weigh about four hunderd tons, and have a working chamber 24 feet wide, 100 feet long and 7 feet high. The design for this outfit has been completed in all its details, and the construction of it is only held up on account of this work having been closed down by the Dominion Government, on account of the War, as being not strictly speaking, essential construction. This arrangement was made two years ago, after considerable investigation by Messrs. Stewart, and the general principle of this device is the same as that used at Halifax, except that the design of the structure has been modified and adapted to shallow water conditions.

The writer is disposed to be charitable, and assume that Mr. McDonald was unaware that the principle and system had been anticipated and had been in successful operation for three years before his design for the Halifax machine was prepared. In further proof of this, if that is necessary, the writer may say, that he was granted a Canadian patent early in 1914 on the device, and a U.S. patent at a later date. This fact may interest Mr. McDonald and his Company in view of possible claims for patent infringement.

You will note, that in the business advertisement of my concern, in the Canadian Engineer and Contract Record, mention is made of the device.

The writer does not wish to unduly criticise, but as the device is hailed as something entirely novel and radical in principle by some of the engineers at the ports of Halifax and St. John, he feels it only just that the facts should be made known to the engineers of Canada as a whole, and fully expects this to be done. *The Journal of the Institute* in publishing an article, no doubt, does not stand sponsor for the claims or statements maffe, but merely publishes it as a matter of interest to the profession.

I will be glad if you will give this statement equal publicity to which it is entitled.

Yours very truly,

JOHN TAYLOR, A.M.E.I.C.

Hamilton, October 24th.

Editor, *Journal:*

With reference to the letter from John Taylor of Hamilton, re the paper read by me on the "Diving Bell used at the Halifax Ocean Terminals" at the third general professional meeting of *The Engineering Institute of Canada,* I beg to reply as follows:

The design of the Halifax apparatus was made prior to, and the detail drawings and specifications were exhibited on, March 15th, 1914—and on March 31st, 1914, the contract for the construction of the Bell was awarded to the Maritime Bridge Company of New Glasgow. The construction was started at once, and the Bell was completed ready for work in the fall of 1914.

The writer and, so far as he knows, the engineers associated with him on the Halifax work were totally unaware of the existance jof the Hamilton apparatus, when the design of the Halifax Bell was made, and furthermore, when preparing the paper referred to, the writer had no knowledge either from the article in the Engineering News or elsewhere, of Mr. Taylor's design.

In the paper the apparatus is called "*A Self-Floating Submerging* and *Raising* type of mobile pneumatic caisson," and the whole context bears out this description of the device. For the sake of clearness in considering Mr. Taylor's letter, I shall quote the only statement of the paper in which reference is made to features believed to be unique.

"The self-raising and floating features of Halifax Bell, the simplicity of the general construction, the method of ballast control, and the great range of depth 20′ to 55′ (a misprint here gives 35′) at which it will work, coupled with its relatively small size in area make it unique."

Regarding the fundamental principles and intrinsic engineering properties of the two machines, the writer has looked up the article referred to re the Hamilton Device in the files of the Engineering News, and after carefully reading the description therein, would say that the following comparison of the two machines can fairly be made. This comparison will clear the issues raised by Mr. Taylor.

The Halifax caisson was designed for work while resting on the harbour bottom at depths up to 55 feet below the water's surface, and the caisson proper, has to be submerged and sunk, under control, to that depth after submergence, and by a reverse operation raised to the surface.

In order to float the caisson, when it was required to be moved, the buoyancy chamber was added, and this was its only function.

The difficult problem was to take care of the sinking and raising of the caisson while submerged. This was solved by the device of a specially proportioned vertical ballast-chamber, which was separate in action and function from the buoyancy chamber and which handled the water ballast proper. The feature of the special ballast chamber is referred to in the quotation given above as "the method of ballast control." This foundamental problem was altogether absent in Mr. Taylor's design, and the principle of using separate buoyance and ballast chambers is not even indicated.

The Hamilton machine was a purely floating device for work about three feet below the surface of the water and was incapable of submergence; it was essentially a pontoon or scow, with a bottomless central well or compartment in which the water level could be lowered by turning in compressed air.

The use of water ballast was not an essential principle of the plant, so far as its use as a floating caisson was concerned; a heavier scow would have served without water ballast. The real purpose of the water ballast in this case was to regulate the draft of the float, so that it could pass over the piling in getting into position, and this device of regulating or changing the depth of flotation of a pontoon, scow or floating device, by admitting water through sea-valves into chambers and forcing it out as required, is an old one, used on floating gates for docks, scows carrying construction plant in tidal waters, etc.

The problem of floatational stability while in the submerged condition was entirely absent in the case of the Hamilton apparatus.

In speaking of stability, Mr. Taylor's statement that his machine was stable—"the metacentre being well *below* the centre of gravity for all conditions"—is surprising; but there is probably a typographical error here.

J. J. MacDonald, A.M.E.I.C.

Halifax, Nov. 8th, 1918.

* * *

Datum Planes in British Columbia

Editor, *Journal:*

In a letter on this subject from Mr. A. G. Dalzell, Secretary of the Committee for a Standard Datum Plane for British Columbia, a correlation of the various datum planes in the Vancouver region is given. (*Journal of the Eng. Inst: of Can:* for November, page 340). As Mr. Dalzell implies that the Government departments are negligent in not adopting uniformity in the matter, a brief statement of the facts of the case seems called for, to explain the situation as it stands at present.

The Committee of which Mr. Dalzell is Secretary, has for its objective to arrive at a uniform system of reference for all levels; but it should be made clear that the discordance which has arisen is not the fault of any Government department, but is entirely due to the very reprehensible practice of Engineers in beginning almost every new undertaking with a fresh and independent datum. If *The Engineering Institute* can throw its influence against this practice, it will be conferring a great benefit on the country; as there are quite recent instances of this in Vancouver itself. A concise review of the facts will clear up the situation; and it is also in itself deserving of being put on record, to exemplify the practice referred to, and the steps already taken to remedy it.

The original datum at Vancouver, established by the Canadian Pacific Railway about 1888, was based on the level of "Ordinary High Water;" and a low-water datum was established in 1891 by the Marine department for the chart survey of Vancouver harbour. In 1901, when the Tidal Survey took up work on the Pacific coast,

careful inquiry was made as to existing datums; and to avoid the introduction of a new one, the Low-water datum of the harbour chart was adopted as the zero level for the tidal observations begun in that year. The relation of this datum to the C. P. R. High-water datum was also definitely established and published on the harbour chart. Yet the Vancouver city datum, the B. C. Electric Railway datum, the North Vancouver city datum and the Pacific Great Eastern Railway datum are all out of accord with these early datums; although the first two and the last two coincide with each other. The Great Northern and the Canadian Northern railways have also brought two new datums into the city recently.

At New Westminster, the Public Works department had established before 1895, a satisfactory Low-water datum for the dredging in the lower Fraser, which was defined by a Bench-mark on the Post Office building This datum was adopted by the Tidal Survey as the zero of the Tide Tables for that region, beginning with those first published for 1901. There were no connected levels between New Westminster and Vancouver at that time. The New Westminster city datum is quite different from this Low-water datum.

At Victoria and Esquimalt, the number of independent datums was even worse. Without attempting any descriptions, they may be mentioned, as follows: The Hudson Bay datum, the basis of a contoured plan of Victoria made in 1883; the Victoria City datum, not quite in accord with this; the Public Works datum in Victoria, and their datum at Esquimalt, which accord closely with each other; the Admiralty datum for the chart of the harbour, found to correspond with the Public Works datum which had already been used for the survey of the inner harbour; and the Royal Engineers' datum at Victoria. At Esquimalt, there is also a Dry-dock datum, used during construction, which is of value indirectly in defining the datum of the Royal Engineers there; as this is not in agreement with their datum at Victoria. Why so many datum levels were adopted may well be asked.

In 1905 the Tidal Survey undertook to correlate all these datums with each other and with the tide levels; and fortunately most of the Engineers who had first-hand knowledge of them, were still in the Province for discussion of the questions involved . This correlation for the three cities named, with full explanations and information for other localities, was published by the Tidal Survey in 1906, under the title " Tide Levels and Datum Planes on the Pacific coast of Canada." This was widely circulated amongst the Engineers on the Pacific coast. The figures given by Mr. Dalzell are based on this publication and on the subsequent determination of Mean Sea level by the Tidal Survey.

It is to be noted in this connection that the primary work of the Tidal Survey, originally a branch of the Marine department, is for the benefit of navigation in obtaining data for tide tables and in the investigation of marine currents. The question of levels was never suggested by the department as part of its functions; but the Survey in undertaking this extra work, has shown that the Government service is willing to go out of its way for the benefit of the Engineering profession, which is the best answer to criticism.

For the determination of Mean Sea level, it is evider that a plane of reference must first be established, an that the levels at the tidal stations must be maintaine constantly with a degree of accuracy which is entirel beyond anything required for the purposes of navigatio or chart soundings. This care has been taken by th Tidal Survey from the beginning, because it was forsee that Mean Sea level would ultimately become a gener plane of reference, as it is in most countries. The followin remark on this was made in a Tidal Survey publicatio as early as 1903: " Eventually as tidal observations a continued, the value of Mean Sea level, extreme tid levels and other factors of importance, are determine with reference to the local Bench-mark at the tid station. Although there is as yet no general system levels in Canada, these results are of service locally in th mean time; and they also furnish a basis for any mo extended geodetic levelling which may be undertaken."

Without describing in detail the precise levelling no carried on for some years by the Public Works departme in the eastern Provinces, or the work of the Geodet Survey of Canada in all parts of the country, it w suffice to say regarding the Pacific coast that the valu of Mean Sea level as now determined by the Tidal Surve at Vancouver and Victoria, are extremely accurate, they are based on eight and seven complete years of tid observations respectively; the value in each year bei derived from the ordinates of the tide curve, hour by hou throughout the year, summer and winter. In th publication of 1906 above referred to, it was not y possible to correlate the datums at Vancouver wi Mean Sea level, as from the tidal point of view this the last result obtained; but approximate values we already given for Victoria and New Westminster. Th tidal record which has now been secured will also enab determinations to be made for the north end of Vancouv island, at the other extreme from Victoria, affording check throughout the island, and also for the heads inlets along the coast of the mainland which may becom railway terminals; and good determinations of Mean S level are already available for Prince Rupert and Po Simpson in the north.

When the Geodetic Survey began its precise levelli on the Pacific coast, the determination of Mean S level at Vancouver was already available, and w utilized as a basis; as tidal observations had been progress for seven years previously. These levels ha now been extended throughout the Fraser river regio but the connection with Blaine at the United Stat boundary is of minor importance, as their best tid station is at Port Townsend on the opposite side Puget sound; with which Blaine is only indirectly connec ed. The primary determination of Mean Sea level Vancouver is thoroughly satisfactory in itself. Th Standard Datum-plane Committee in British Columbi in adopting the datum of the Geodetic Survey, may th be assured that the basis for Mean Sea level determined by the Tidal Survey at the north and sou ends of the mainland coast, as well as in Vancouv island, is thoroughly accurate.

The Geodetic Survey of Canada in the Interi department, which has recently been made a speci

branch of the Government service, has now carried connected levels completely across the continent, connecting Vancouver with Mean Sea level at Halifax, as determined there by the Tidal Survey. The Dominion Railway Commission has also approved of Mean Sea level as the best general basis for levels, wherever it is practicable to obtain connection with it.

It is to be hoped that Engineers will thus recognize that the various Government departments have provided an ample basis for a uniform datum throughout the country, and have even had the foresight to determine data for this in advance of requirements. *The Engineering Institute* will therefore doubtless be willing by its influence and through its publications to encourage the use of such a datum by Engineers throughout Canada.

W. Bell Dawson, D.Sc., M.E.I.C.
Superintendent of the Tidal and Current Survey,
Department of the Naval Service, Ottawa, Ont.

November 15th, 1918.

* * *

Editor, *Journal:*—

I would like you to convey to the Council and corporate members of *The Engineering Institute of Canada*, my heartfelt thanks and keen appreciation of their gift of pipe tobacco just received. It is a most welcome gift I assure you and I am delighted to be so remembered by *The Instiute.* Words can hardly express the emotion which fills my heart but I ask you to accept the warm and sincere thanks of such an unworthy member and recipient as myself. Your gift is greatly welcome and I thank you.

I am glad to say I am in good health. I am as fit as the proverbial fiddle and my only complaint is that I am putting on flesh and now weigh about fifteen pounds heavier than I was when I left Vancouver — three years ago. I am back in India again, and I am stationed at the headquarters of our corps at Bangalore. I was returned for duty as Commander of a newly raised field company and I am now O.C. 67 Field Company. I have just completed a period as senior instructor to a class of pioneer officers — which job was most enjoyable.

Yours faithfully,

D. B. McLay, Lieut. R.E., A.M.E.I.C.
Officers' Mess,
2nd (Q.V.O.) Sappers & Miners,
Bangalore, India,
30th August, 1918.

* * *

Editor, *Journal:*—

I have just received by this week's mail the cigarettes and greetings sent by the Society, these have been somewhat delayed hence delay in acknowledgement.

Please accept my hearty thanks for the sentiments and wishes conveyed by the card and for the cigarettes.

May I be allowed to say that I am proud of being a member of the Can. Soc. C.E. the membership of which is so largely represented in the Forces of the Dominion.

I am, dear Sir,
Yours faithfully,

Chris. Wilson Brown, Captain, S.E.I.C.,
IX Sudanese, Nyala, Sudan.

Education Needed

Editor, *Journal:*—

An assistant accountant, a common every-day clerk or a photographer are offered $1,600 to $2,100 by the C. S. commission and a full fledged Engineer $1,200 to $1,500. This is ridiculous Won't you kindly educate the Civil Service Commission to discern between the knowledge of the above classes of future civil servants and offer salaries accordingly.

A Member of the E.I.C.

The "Legal" Engineer?

Editor, *Journal:*—

Apropos of legislation.

Scene in Court:—

Crown Prosecutor to Witness, Mr — In accordance with the instructions given you, you have prepared certain plans of service in this case?

Witness,— That is so.

Hurried interjection by Magistrate,— Is he a qualified man, and to Witness severely, — Are you a qualified surveyor?

Witness,— No, I am not. Some dejection on the part of C. P. and enquiry to Witness, Mr.— You are an Engineer in the public service are you not? Witness, Yes and fully competent to produce plans for this purpose, which is not in any way related to the registration of lands and for which a legal surveyor would be required.

Magistrate again hurriedly and severely,— Are you a qualified Engineer?

M's tone implied that he required a legal assurance of this fact and Witness knew that in that sense he could not give it, so in spite of his oath and as a matter of fact answered,— "Yes." being thankful that the custom of flu masking was in fashion so that the austere judge could not see the involuntary smile which flitted across his face at the absurdity of his position.

There is no such thing as a "legally qualified" engineer.

Gentlemen of the profession, it is up to you to see that this absurdity does not longer continue. In court the surveyor is an accepted fact, something which the legal mind can comprehend and accept, but the "engineer" what is he?

So far as the law is concerned and his legal status in court before and amongst other professions, neither fish, fowl nor good red herring. No competent engineer needs the rank "that is but the guinea stamp," but he does need to stand with his fellow professionals upon an equal footing before and in the eyes of the law. In such circumstances as are indicated above, the Court can receive and understand with ready acceptance the legal surveyor, medico, dentist, osteopath, druggist, nurse, architect, embalmer, even the plumber and the lawyer, but the "engineer" who and what is he? Step up, gentlemen into your rightful place, your conspicuous modesty has left you in an inviduous position which you alone can correct by concerted action for which the time is fully ripe.

The "Illegal" Engineer,
A.M.E.I.C.

PERSONALS

John Marshall, A.M.E.I.C., (a war veteran) has left Regina to spend the winter at Los Angeles, Cal.

J. C. Meade, A.M.E.I.C., formerly a Lieutenant in the C.E.F., has been appointed a sub-inspector Dominion Police, Regina.

L. A. Thornton, M.E.I.C. and a member of the Council is at the head of the Victory Loan organization for Regina district.

E. N. Johnson, A.M.E.I.C., resident engineer C.N.R., Regina, has recovered from a serious attack of typhoid fever and resumed his duties.

Lt. W. E. Longworthy, S.E.I.C., of Regina, a member of the Saskatchewan Branch, has been wounded for the second time in ten days, the last wounds being of a serious nature.

C. V. Putman, a junior member of the *Institute*, who has been assistant engineer, Water Works Department, Ottawa, has resigned this position and is now with the efficiency department of the Civil Service Commission.

Major N. C. Sherman, A.M.E.I.C., who has been for some time a member of the War Purchasing Commission at Ottawa, left recently with the Canadian Expeditionary Force to Siberia. He will occupy the important position of Inspector of Ordnance Machinery.

A. C. Eddy, M.E.I.C., who until recently has been an officer of the British Columbia Electric Company, has left Vancouver to engage in war work with the United States Government. His present position is Captain, 55th Engineers, U. S. Army.

William Robert Worthington, B.A.Sc., A.M.E.I.C., who has been for some time with the Toronto department of works, as chief engineer of the sewer section, is at present also acting engineer to the Ontario Board of Health during Captain Dallyn's absence in Siberia.

Gilbert Murray, A.M.E.I.C., has been promoted to the position of resident engineer G.T.P.R. at Melville, Sask., succeeding Sherman Smith a former member of the *Institute*, who has been made assistant superintendent G.T.P.R., with headquarters at Edson, Alta.

Charles Avary Lee, A.M.E.I.C., until recently purchasing agent of the British Columbia Electric Company of Vancouver, has returned to the domain of Uncle Sam and is at present, U. S. N. R. F., Bureau of Yards & Docks, Navy Department, Washington, D.C. Mr. Lee is a graduate of Cornell University.

A. E. Doucet, M.E.I.C., member of Council, has been appointed by the city commissioners of Montreal as director of public works, succeeding Paul E. Mercier, M.E.I.C., who is now consulting engineer for the city. J. R. Barlow, M.E.I.C., engineer superintendent of the roads department, who retired recently, has been granted a pension equivalent to one half his recent salary.

W. T. Thompson, M.E.I.C., (Saskatchewan Branch), one of the oldest members of the *Institute* and the oldest land surveyor still practising in Saskatchewan received a wire recently that his second son paid the supreme sacrifice. The sympathies of the Saskatchewan Branch and of the *Institute* at large will be extended to the parents who have given two of their sons in this world struggle for democracy.

F. W. Townsend, A.M.E.I.C., (Saskatchewan Branch) is supervising the erection of thirty large cottages, which the Imperial Oil Company are erecting at considerable expense in the vicinity of their new refinery at Regina. This will take care of the scarcity of dwellings in this City to some extent, and prove also of considerable benefit to the officials etc. of the company, providing homes in the vicinity of their work.

Major T. R. Loudon, A.M.E.I.C., invalided home from France in January 1918, has recently been appointed officer commanding the Royal Canadian Engineers, military district number 11, which includes British Columbia and Vancouver Island, with charge of all military engineering work. Before going overseas in 1916 Major Loudon was a lecturer in the faculty of applied science, University of Toronto and is a member of the firm of James, Loudon & Hertzberg Ltd.

B. E. Norrish, B.Sc., A.M.E.I.C., formerly Supt. of Commercial Exhibits Branch, Dept. of Trade and Commerce, Ottawa, has been appointed by the Dominion government to take charge of the Federal moving picture work, with which he has already had considerable experience. It is proposed to more fully advertise Canada by means of moving pictures, and arrangements have already been made for the exhibition of Canadian films in the United Kingdom, Australia, New Zealand and South Africa.

Lieut. Col. C. S. L. Hertzberg, M.C., M.E.I.C., a member of the firm of James, Loudon & Hertzberg Ltd., consulting engineers of Toronto, has left for Siberia as conducting officer in charge of an engineer company to prepare quarters for the Canadian Expeditionary Force. Lieut. Col. Hertzberg went overseas in 1915 where he won the Military Cross for conspicuous bravery and was invalided home in 1917. His new appointment is undoubtedly a recognition of his valuable services in France.

Capt. L. Kirk Greene, S.E.I.C., of 598 Pine Ave. West, has returned to Montreal after three years' service with the Allied Armies. Capt. Greene was a student at McGill University and a student member of the *Institute* and enlisted in June 1915 with the 5th C.M.R. (with the late Major Kenneth Duggan) and was machine gun officer with that regiment in France until August, 1918, when, being an ardent athlete he was recommended for the British Training Commission in the United States. He served in this capacity in charge of physical and bayonet training, until November, when he returned to Montreal. It is Capt. Greene's intention to return to McGill University to finish his course.

M. H. MacLeod, M.E.I.C., member of Council, formerly general manager and chief engineer of western lines, has been appointed vice-president of the Canadian Norther Railway, in charge of construction, maintenance and operation of all lines, with headquarters at Toronto. Mr. MacLeod was born at Skye, Invernesshire, Scotland, on July 13, 1857; commenced his railway career in 1877 as chainman of the Victoria Railway in Ontario. From 1883 to 1900 he was with the Canadian Pacific Railway, in various engineering capacities, at one time chief engineer and superintendent of the Crows Nest branch. Mr. MacLeod's experience and ability are thus recognized in the important position to which he has just been appointed.

OBITUARIES

Melville Alfred Kemp, A.M.E.I.C.

The Influenza epedemic was responsible for the death in Hamilton on October 19th, of Melville Alfred Kemp, B.Sc., of Toronto, Ont., who was engaged in Hamilton in the Department of Inspection, Imperial Ministry of Munitions. The late Mr. Kemp was an Associate Member of the *Institute*, was born at Huntley, Ont., on August 29th, 1883, graduating as a civil engineer from McGill University in 1912. Since then he was engaged by the Dominion Government, and later was with the Department of Roads and Highways in Ontario, as assistant engineer; entered the *Institute* as a Junior in 1912, and was transferred to associate membership in January 1917.

Henry Badeley Smith, M.E.I.C.

Henry Badeley Smith, M.E.I.C., died suddenly at his home on Georgia Street, Vancouver, on November, 1st. The late Mr. Smith was born near Melrose, Scotland, on July 26th, 1850; entered the *Institute* as a member on the 2nd of December 1887, the year the Canadian Society of Civil Engineers was incorporated. After considerable engineering work on railway construction he became designing construction engineer for the water works system of the city of Vancouver. Later he centered his activities at Rossland, and from 1909 to the time of his death, the late Mr. Smith was in active general practice in the city of Vancouver. He was a man of retiring disposition and was highly esteemed by those whose privilege it was to know him.

T. Aird Murray, M.E.I.C.

T. Aird Murray, M.E.I.C., consulting engineer of Toronto, died in the Grey Nuns Hospital, Regina, November 5th, from influenza, after an illness of only five days. The late Mr. Murray was born at Dumfries, Scotland, on June 3rd, 1866 and commenced his engineering career in 1887 as assistant to A. S. Dinning, Newcastle-on-Tyne. In 1891 he became engineer for the North Eastern Sanitary Association which position he occupied until 1894 when he entered into private practice at Sheffield. Coming to Canada in 1908 the late Mr. Murray settled in Toronto where he was engaged as consulting engineer, having specialized in sewerage disposal and sewerage schemes. In 1909 he was admitted to the *Institute* as a member. Throughout his career he was actively interested in public health, belonging to the Canadian Health Association and the American Public Health Association, and was in addition a member of the Engineers' Club of Toronto and the Assiniboia Club of Regina. Mrs. Murray resides at Oakville. His only son was killed in action two years ago.

William A. Cowan, M.E.I.C.

William A. Cowan, A.M.E.I.C., superintendent of the Transcontinental Railway from Quebec to Cochrane, died on Sunday, November 17th, a victim of the epidemic of influenza. The late Mr. Cowan was an honour graduate of the School of Practical Science, Toronto in 1904. Following his graduation he became associated with the Canadian Pacific Railway as transitman in charge of track centering and steel relaying. In 1905 he became assistant engineer of terminals at Toronto following which he was for a number of years resident engineer for the Canadian Pacific Railway. He later became Associated with the Transcontinental Railway and at the time of his death, at the age of forty-one, he occupied an important position in railway engineering in Canada, having supervision over three divisions of the Transcontinental Railway. He was born at Galt, Ont., on June 22nd, 1877, and entered the *Institute* as an associate member in 1907.

Calvin P. Wilson, S.E.I.C.

Lieut. Calvin P. Wilson, S.E.I.C., who has been attached to the R.C.G.A., in Halifax, died of influenza in the military hospital there, on Sunday, October 20th. The late Lieut. Wilson was born in Huntley, Ont., March 26th, 1888, and entered the *Institute* when in his third year in McGill University, in 1912.

H. G. Sidenius, M.E.I.C.

The Calgary branch lost one of its most valued members in the death of Capt. H.G. Sidenius on Nov. 7th, 1918. Capt. Sidenius joined the *Institute* as an Associate member in June 1910, and was transferred to full member in 1915. He has been actively associated with the Calgary Branch since its formation, having served as a member of its Executive Committee for the past three years and always took a keen interest in all matters affecting the profession and the Institute. He was a Dane by birth and was a graduate of the University of Copenhagen, and followed his profession for some years in South Africa in waterworks construction, coming to Canada about ten years ago. He has since for the greater part of the time been employed on the irrigation projects of the Canadian Pacific Railway having been the field engineer in charge of the construction of the Bassano Dam.

Capt. Sidenius was attached to the Fourth Field Troop, Canadian Engineers and during 1916 and part of 1917 was Instructor at Sarcee Camp, Military District No. 13 in "Military Engineering and Trench Warfare".

At the time of his death he was assistant to the chief engineer, department of Natural Resources, Canadian Pacific Railway at Calgary.

He is survived by a widow and two children.

Preliminary Notice of Application for Admission and for Transfer

1st December, 1918.

The By-Laws now provide that the Council of the Society shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to Secretary any facts which may affect the classification and election of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described in December, 1918.

FRASER S. KEITH, Secretary.

*The professional requirements are as follows:—

Every candidate for election as MEMBER must be at least thirty years of age, and must have been engaged in some branch of engineering for at least twelve years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in some school of engineering recognized by the Council. The term of twelve years may, at the discretion of the Council, be reduced to ten years in the case of a candidate who has graduated in an engineering course. In every case the candidate must have had responsible charge of work for at least five years, and this not merely as a skilled workman, but as an engineer qualified to design and direct engineering works.

Every candidate for election as an ASSOCIATE MEMBER must be at least twenty-five years of age, and must have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineers' office, or a term of instruction in some school of engineering recognized by the Council. In every case the candidate must have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years.

Every candidate who is not a graduate of some school of engineering recognized by the Council, shall be required to pass an examination before a Board of Examiners appointed by the Council, on the theory and practice of engineering, and especially in one of the following branches at his option Railway, Municipal, Hydraulic, Mechanical, Mining, or Electrical Engineering.

This examination may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five years or more years.

Every candidate for election as JUNIOR shall be at least twenty-one years of age, and must have been engaged in some branch of engineering for at least four years. This period may be reduced to one year, at the discretion of the Council, if the candidate is a graduate of some school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-five years.

Every candidate who is not a graduate of some school of engineering recognized by the Council, or has not passed the examinations of the first year in such a course, shall be required to pass an examination in the following subjects Geography, History (that of Canada in particular), Arithmetic, Geometry Euclid (Books I.-IV. and VI.), Trigonometry, Algebra up to and including quadratic equations.

Every candidate for election as ASSOCIATE shall be one who by his pursuits, scientific acquirements, or practical experience is qualified to co-operate with engineers in the advancement of professional knowledge.

> The fact that candidates give the names of certain members as references does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

ALISON—ANDREW MATTHEW, of Prince Rupert, B.C. Born at Toronto, 3rd Jan. 1886. Educ. private tuition and I.C.S. 1904-1909, with the C.N.R. as rodman, leveller, etc. 1911, engr. hydro-elec. survey, city of Prince Rupert; 1912, instrumentman on R.R. constrn., Canadian Collieries Ltd., Nanaimo, B.C. 1913, instrumentman on constrn. G.T.P. Ry. west of Fort George; 1916, timekeeper and instrumentman on constrn. Union Stock Yards; 1917, leveller, drainage survey, Man. Govt., 1908, asst. engr. constrn. of Maryfield Branch, C.N.R., and 1918, asst. engr. on bridge filling, etc. At the present time, instrumentman, maintenance of way, G.T.P. Ry., B.C.

References: M. H. Macleod, T. Turnbull, Wm. Burns, R. W. McKinnon, G. Murray.

BRIERCLIFFE—HENRY CARLE DYSON, of Winnipeg, Man. Born at Millbrook, Man. on May 29th, 1887. Educ. St. Johns Coll., Winnipeg, B.Sc. (Mech. Engr.) McGill Univ. 1911. 1904-06, apprentice mechanic C.P.R. shops, Winnipeg, 1911-14, Dominion Bridge Co., Montreal, as engr. draftsman & checker on all kinds of movable bridges, elec. travelling cranes, shop, machinery and allied work, 1915 with Manitoba Shell Co., St. Boniface, Winnipeg, designing special shell machinery, 1916-17, Dominion Bridge Co., Winnipeg, designing standard & special shell shop equipment and detailing of structural steel (bridges, buildings and elevator work), 1917-18, designing, drafting & mech. engr. at Vulcan Iron Works, Winnipeg, 1918 and at present time with R.A.F., Toronto.

References: F. P. Shearwood, R. J. Durley, A. R. Roberts, A. E. Johnson, F. Newell.

CAMERON—CHARLES FREDERICK, of Winnipeg, Man. Born at Winnipeg, 7th June, 1889. Educ., B.A., B.C.E. Univ. Manitoba, 1911-12. Summers, 1906-7-8-9, rodman and instrumentman on the C.N.R., Winnipeg; summer, 1910, asst. engr. on construction of Oak Point extension, C.N.R. May-Nov. 1911, asst. engr. on constrn. of Brazeau Branch; also from May 1912-Jan. 1914; May-Nov. 1914, asst. engr. on track laying; demonstrator in physics, Univ. of Manitoba during 1918, asst. engr. on location and constrn.; 1915-16, asst. engr. on bridge filling and location; 1918, asst. engr. on track laying; demonstrator in physics, Univ. of Manitoba during sessions; and with the C.N.R. as above during vacations.

References: A. T. Fraser, T. Turnbull, Wm. Burns, E. E. Brydone-Jack, R. W. Moffatt.

GABY—FREDERICK ARTHUR, of Toronto, Ont. Born at Richmond Hill, Ont., 26th March 1878. Educ., Grad. S.P.S. (honors), Toronto 1903, B.A.Sc., Univ. of Toronto (honors) 1904, M.E., E.E.; 1904-06 erecting engr., Canadian General Electric Co.; Dec. 1906, asst. elec. engr., power construction dept. City of Winnipeg; at the present time chief engr. Hydro-Electric Commission, Toronto.

References: R. A. Ross, W. J. Francis, J. B. Challies, P. H. Mitchell, W. F. Tye, H. G. Acres.

GLASSCO—JOHN GIRDLESTONE, of Winnipeg, Man. Born at Hamilton, Ont., Sept. 10th, 1879. Educ. B.Sc. and M.Sc., McGill Univ. 1900; 1900-1, with testing dept., Montreal Light Heat & Power Co.; 1902-3, demonstrator, Electrical Dept., McGill Univ.; 1903-5, foreman, test & repair, Edison Electric Co., Los Angeles, Cal.; 1905-9, elec. engr., Dominion Power & Transmission Co., Hamilton; 1909-12, elec. engr., Smith Kerry & Chace; 1912 to date, manager of City of Winnipeg hydro-electric system.

References: L. A. Herdt, R. S. Lea, W. M. Scott, W. P. Brereton, W. Arch'd Duff.

MARRS—CHARLES HAWKINS, of Hamilton, Ont. Born at Beamsville, Ont., Apr. 19th, 1879. Educ. Hamilton Coll. Inst., honors in School of Practical Science, 1902, wrote thesis on design of railway plate girder bridges & obtained C. E. degree from Univ. of Toronto, 1913. 1902 (4 mos.) with G.T.R. on survey work, 1902-07 with Hamilton Bridge Works on detailing steel structures and on checking important work, 1907-12 with Riter Conley Mfg. Co., Pittsburg, under Mr. Bowman, in chg. of design of buildings, bridges towers, etc., 1912-18 with Hamilton Bridge Works in chg. of engr. dept. and of all designs on swing and fixed bridges and buildings of all descriptions. At present time asst. engr. of the Hamilton Bridge Works in chg. of all designs and estimates and work in the field.

References: E. R. Gray, F. Paulin, G. Hogarth, R. Latham, J. A. McFarlane, E. H. Pacy, E. H. Darling, T. Taylor.

PATTERSON—EARLE BEDFORD, of Winnipeg, Man. Born at Listowell, Ont., 22nd Feb., 1883. Educ. Toronto School of Practical Science, 1909, 1903 chainman on land survey, 1903 rodman on constrn. C.N.R. 1907 chainman on location N.T.R., 1908 rodman on costr. G.T.P.Ry., 1909 (8 mos.) assistant on D.L.S. with S. J. Lonergan, D.L.S., 1909-11 with Messrs. Smith Kerry & Chace on concrete work at Point du Bois, hydro-elec. development, 1911-12 asst. engr. in chg. of party for Dominion Water Power Br. on Winnipeg river power survey, 1912-13 res. inspecting engr., La Colle Falls, power development of City of Prince Albert for Dominion Water Power Br., at present asst. engr. Manitoba Hydrometric Survey.

References: W. M. Scott, W. G. Chace, W. P. Brereton, M. C. Hendry, J. T. Johnston.

PERKINS—H. W., now on Active Service. Born on Feb. 5th, 1888. Educ. High School, Port Hope, Ont. With MacKenzie, Mann, 1907, chainman on constr., 1909-10 leveller and transitman, 1910-14, res. engr. of constr. Div. B. section 2, Port Arthur-Sudbury line, 1915 (6 mos.) with Canadian Government as asst. engr. on Toronto Harbour during investigation, 1915-17 transitman with Hydro-Electric. Power Comm. on Hydro-radial projects, 1917 and at present time with C.E.F.

References: A. F. Stewart, H. T. Hazen, E. W. Oliver, G. Scott, E. T. Agate, G. F. Hanning.

PICKINGS—HARRY BURTON, of Halifax, N.S. Born at Halifax, N.S., April 8th, 1884. Educ. C.E. course I.C.S.; course in assaying, N.S. Tech. Coll.; with Dept. of Public Works & Mines, N.S. Government, as follows: 1901-5, asst. to engr. and Deputy Inspector of Mines; 1905-9, acting engr. and Deputy Inspector of Mines; 1910-12, Deputy Inspector and engr., Mines Dept.; 1913 to date, private practice, member of firm Pickings & Roland, Halifax, N.S.

References: H. Donkin, K. H. Smith, D. H. McDougall, C.E.W. Dodwell.

POWERS—THOMAS EDWARD, Lt. Col., D.S.O., of Ottawa, Ont. Born at St. John, N.B., 7th Sept., 1874. Educ. B.A., Univ. of N.B. 1895 and military training in telegraphy, telephony and military engr., reconnaissance and constr. telegraph and telephone systems aerial and buried. 12 yrs. instructor math. and science St. John High School, 3 yrs. mech. engr. in chg. of sales dept. and making and checking efficiency reports for maritime provinces, 3 yrs. O.C. 1st and 3rd Divisional Signal Cos. on Active Service in France. At present time officer administering R.C.E. and tech. branches in connection with C.E., embracing engrs., Signal Ry. Troops and Forestry Corps.

References: C. O. Foss, A. P. Deroche, J. B. Challies, E. A. Jamieson, J. A. Walker.

REID—FREDERICK BLAIR, of Ottawa, Ont. Born at Bowmanville, Ont., 17th Oct. 1883. Educ. B.A.Sc., Toronto Univ. 1904; vacation 1902, on Dom. Land survey party; vacation 1903, with Bay of Quinte Ry.; 1904-7, asst. res. engr. on Oshawa, Ont. water works and res. engr. in chg. of installation of Port Elgin and Thorold, Ont. water works and Brampton, Ont. sewerage system, for Willis Chipman, of Toronto; with Geodetic Survey of Canada as follows: 1908-9, in chg. of precise levelling party; 1909-14, inspector of levelling; 1914 to date, supervisor of levelling

References: J. White, W. B. Dawson, W. J. Stewart W. Chipman, N. J. Ogilvie, M. F. Cochrane, J. D. Craig.

SCHACHERE BERNARD, of Ottawa, Ont. Born at Paris, France on July 12th, 1882. Educ. B.Sc. Cooper Union Institute, New York City, N.Y., 1910, McGill Univ. Extension Courses, 1912 reinforced concrete, 1913 and 1914, Stat. Indet. structures and secondary stresses. 1910 draughtsman with Westinghouse Church, Kerr & Co., N.Y. City, 1911 draughtsman with Exeter Machine & Iron Works, Pittston, Pa., 1911-13 checker with National Bridge Co., Montreal, 1913 to date calculator with board of engineers, Quebec bridge, Montreal and Ottawa.

References: C. N. Monsarrat, H. P. Borden, A. J. Meyers, M. B. Atkinson, M. A. Sammett.

STALFORD—VICTOR KENNEDY, of Hamilton, Ont. Born at Toronto, Ont., Aug. 20th, 1889. Educ. Tech. High School; diploma, I.C.S.; 1909-10, holder of Provincial Stationery Engineer's Certificate, 1908-10, engr. in chg. of watch in 4,500 H.P. steam-electric plant; 4 yrs., foreman inside wireman for Can. Westinghouse Co., 1914, city electrical inspector; private consulting practice on lighting and power installations with local Architects, Engineers & Contractors; 1915 to date, District electrical inspector for Hydro-Electric Power Commission of Ontario; 1917, designed and supervised lighting and power installation for Can. Cotton Co. Ltd., Hamilton, Ont.

References: R. L. Latham, E. R. Gray, H. B. Dwight, E. H. Darling, J. A. McFarlane, H. U. Hart, W. D. Black.

FOR TRANSFER FROM THE CLASS OF ASSOCIATE MEMBER TO THAT OF MEMBER

CAGNAT—Georges Henri, of Edmonton, Alta. Born at St. Jean de Maurienne, France on Dec. 11th, 1870. Educ. Engineering School, Lille, France and Electro-technical School of Liege, Belgium. 1893-96 elec. engr. on Transiberien Ry. at Wilna Div., 1896-1900 engr. on constr. of tunnel at Linglon, Switzerland, 1900-08 engr. for Credit Franco-Canadian, Montreal, on sewers and waterworks, 1908-12 Dept. of Public Works, Ottawa on sewers, waterworks & hydro-electric plant at Rimouski, Huntingdon and Levis, 1912-18 dist. engr. Dept. of Public Works, Edmonton, Alta.

References: A. St. Laurent, E. D. Lafleur, C. R. Coutlee, U. Valiquette, S. J. Chapleau.

DUFF—WILLIAM ALEXANDER, of Moncton, N.B. Born at Hamilton, Ont. Apr. 20th 1877. Educ. S.P.S., Toronto, 1901. 1901-02 (6 mos.) draughtsman & acting res. engr. Vancouver, Victoria & Eastern Ry., B.C., 1902-03 asst. engr. on constr. G.T.R., Hamilton, Ont., 1903-04 draughtsman and checker, Kenwood Bridge Co., Chicago, Ill., 1905-07 draughtsman and checker, Canadian Bridge Co., Walkerville, Ont., 1907-08, ch. draughtsman, bridge dept., Transcontinental Ry., 1908-13 asst. engr. of bridges, Transcontinental Ry., Ottawa, 1913-16 engr. of bridges, Canadian Government Rys. Moncton, N.B., 1916 to date asst. ch. engr. & engr. of bridges, Canadian Government Rys., Moncton, N.B.

References: F. P. Gutelius, C. B. Brown, F. P. Shearwood, P. Johnson, R. F. Uniacke.

FOR TRANSFER FROM CLASS OF JUNIOR TO HIGHER GRADE

EARDLEY-WILMOT—TREVOR, of Montreal, Que. Born at Stratford, Ont. Oct. 17th, 1889. Educ. B.Sc., elec. engr. McGill Univ., 1913. 1907-09, Canadian General Electric Co., Peterboro, Ont. and summer 1910, summers of 1911 and 1912 inspector of all underground conduit work for Montreal Light Heat & Power Co., 1913-15 in chg. of Cable Installation Dept. of Imperial Wire & Cable Co., Montreal, estimating and supervising the installation and designing all necessary apparatus for same; with Northern Electric Co., as follows: 1915-17 installation dept. estimating on elec. constrn. and supervising underground cable work, 1917-18 in chg. of design and constr. of telephone and power cables, cable engineering dept. At present time cable engr. with Northern Electric Co.

References: J. M. McCarthy, E. G. Burr, C. V. Christie, M. S. Blaiklock, J. S. Cameron.

MILNE—JOHN EVANS, of Edmonds, B.C. Born at Belfast, Ire., 16th May, 1882. Educ. 3 yrs. Belfast Tech. Inst.; 1897-1900, Univ. Coll., Belfast (evening sessions); 1900-2, asst. with Cooper & Waters Consl. Engrs., Belfast, sewage and municipal work; 1902-3, asst. engr., Gt. Northern Ry., Ireland; 1903-6, res. engr. County Council of Down, Ireland, on harbour work, road constrn.; 1906-7, res. engr. County Council of Antrim, Ire., on constrn. street ryl's and pavements; 1907-8, transitman, C.P.Ry.; 1908-9, res. engr. County Council of Down, Ire.; 1909-10, asst. engr. track work, C.N.Ry.; 1910-11, transitman on location and constrn.; 1911, (6 mos.), highway engr., Manitoba Govt.; 1911-12, contractors engr. H. B.Ry.; 1912-13, highway engr., Sask. Govt.; 1913-14; contracting; 1914-16, Sask. Govt.; 1916-18 in C.E.F.; at present, municipal engr., Corporation of Burnaby, Edmonds, B.C.

References: C. Brackenridge, W. B. Greig, H. Stewardson, A. D. Creer, W. A. James.

FOR TRANSFER FROM CLASS OF STUDENT TO HIGHER GRADE

WAY—WILLIAM RUSSELL, of Montreal, Que. Born at North Bay, Ont. on May 29th, 1896. Educ. B.Sc. in E. E. McGill Univ. 1918. 1914 (5 mos.) rodman, C.P.R. survey party, Farnham, Que., 1915 (4 mos.) ast. surveyor, Hollinger Mines, Ltd., Timmins, Ont., general surface and underground surveying, 1916 (4 mos.) draughtsman, Northern Electric Co., Montreal, telephone engr. work, 1917 (4 mos.) asst. engr. Northern Electric Co., designing and supervising the manufacture of high tension power cables, 1918 (5 mos.), lieut. R.C.E., honorably discharged, Aug. 1918 to date asst. elec. engr., operating dept., Shawinigan Water & Power Co., Montreal, asst. to C. R. Reid, E.E., on general elec. work.

References: Julian C. Smith, C. V. Christie, J. Morse, E. Brown, L. A. Herdt, H. M. MacKay, A. R. Roberts, T. R. Deacon.

Survey Cooking

When I started out on surveys
I was happy, young and strong;
I went early to my dinners,
And I tarried with them long.

But time, and that survey cooking,
Have left but a wreck of me
Those oft time outing menus
Have made the change you see.

Instead of beef and victuals
They fed me on the worst
Until they killed my spirit,
My mind has likewise burst.

At last there came a stranger,—
A chef from the C.N.R.
He hired to cook my dinners,
But my system got a jar.

His grub, it was the crudest
That ever mortal ate.
T'was served in style the rudest
Like a German hymn of hate,

I said to the gentle stranger,—
That chef from the C.N.R.
" What tell do you thing you're doing
My digestion thus to mar?

I hired you to cook my dinners,
And you almost take my life.
My mouth is full of gravel,
And my stomach's full of strife."

Then out came the shameful story,
And it took my breath away;
He'd once been chef on a cattle car,
And had fed the beasts their hay.

An Associate Member

Precise Levelling

Noel Ogilvie, M.E.I.C., superintendent of the Geodetic Survey of Canada, Department of the Interior, has forwarded to the Institute Publication No. 1 on Precise Levelling, which is the first report issued by the Geodetic Survey of Canada as a separate branch of the Department of the Interior. Besides giving the results of levelling on certain lines in Quebec, British Columbia and Ontario, it contains a valuable index map showing all the work previously published. In addition it contains tables of the elevations at various points throughout Canada, rail elevations and an alphabetical list of cities, towns and villages at or near which bench-marks have been established. This publication is available to the members of *The Institute* upon application to Mr. Ogilvie.

ENGINEERING INDEX

In this department will be published from month to month the titles of current engineering papers with the authors and source and a brief extract of the more important. It is designed to give the members of The Institute a survey of all important articles relating to the engineering profession and to every branch of the profession.

PHOTOSTATIC PRINTS

[illegible]

Harrisson W. Craver, Director,
Engineering Societies Library,
29 West Thirty-ninth Street, New York, N.Y.

AERONAUTICS

AEROSTATICS. Military Aerostatics H. K. Black. Aerial Age, vol. 8, no. 4, Oct. 7, 1918, p. 169, 1 fig. Observation balloon in Navy. (Continuation of serial.)

AIRPLANE THEORY. The Flight of an Aeroplane at Different Altitude, Louis de Bazeilles. Translated from original French by B. Bruce Walker. Flight, vol. 10, no. 30, July 25, 1918, pp. 836-837, 1 fig. The logarithmic diagram formulae for resistance and total lift for unit speed. (Concluded.)

ATLANTIC FLIGHT. Atlantic Flight, M. A. S. Riach. Times Eng. Supp., no. 528, Oct. 1918, p. 216. Analysis of possibility of constructing an aeroplane capable of making journey in single flight.

BRITISH AEROPLANES. The Sopwith Camel. Flight, vol. 10, no. 37, Sept. 12, 1918, pp. 1019-1022, 11 figs. Description of machine F. I. B. 6290 built by Sopwith Aviation Co. Translated from German paper. (See also Aviation, vol. 5, no. 6, Oct. 15, 1918, pp. 361-362, 6 figs.)

ENGINEERS, AERONAUTICAL. The Education of Aeronautical Engineers. Aeronautics, vol. 15, no 250, July 31, 1918, p. 96. Account of work being done in France.

The 180-hp. Mercedes Aircraft Engine. Automotive Ind., vol. 39, no. 11, Sept 12, 1918, pp. 453-456, 9 figs. Fuel test results and table of data of development of 160-hp. model, having same cylinder dimensions, compression increased and details redesigned.

ENGINES. The design of Aeroplane Engines (VI), John Wallace. Aeronautics, vol. 15, nos. 253, 254, 256, 257, 258, 259, Aug. 21, 28, Sept. 11, 18, 25, Oct. 2. 1918, 163-164, 4 figs, 200-202, 1 fig., 236-238, 5 figs., 267-269, 7 figs., 295-297, 9 figs., 317-320, 15 figs. Aug. 21: Torque reaction; side-thrust upon cylinder walls; Désaxé cylinder; Aug. 28; weight power ratio; weight cylinder capacity ratio; rotary motor; power cylinder capacity ratio; weight/power ratio; mean effective pressure; Sept. 11: Volumetric efficiency; pumping losses; gas velocity; speed of revolution, effects of increased inertia forces; piston speed; speed of propeller shaft; cylinder dimensions; stroke to bore ratio; Sept. 18: Cylinder design; objections to cast cylinders; example of side-valve cylinder; overhead valve cylinder construction; valve ports; valve guides; Sept. 25: Construction and mounting of cylinders; water jackets; colonnette bolts; strength of cylinders; 160-hp. Benz cylinder; Mono Gnome cylinder; detachable cylinder heads; Oct. 2: Poppet valves; materials for valves; proportions of valves; operation of slide valves; valve springs; operation of overhead valves; Beardmore gear; camshafts; openings and timing valves.

The 300-hp. Maybach Engine. Flight, vol. 10, nos. 35, 37, 38, Aug. 29, Sept. 12, Sept. 19, 1918, pp. 962-965, 10 figs., 1031-1035, 12 figs., 1059-1063, 12 figs. Aug. 29: General features; details of cylinders, pistons, gudgeon pins, and floating small-end bushes. Issued by Tech. Dept., Aircraft Production, Ministry of Munitions: Sept. 12, Propeller hub; lubrication, crankcase ventilation; constructional details of oil pumps; Sept. 19, carburators; resistance test; atomization test; petrol pump; delivery tests; starting gear. Issued by Tech. Dept. Aircraft Production Ministry of Munitions. Also published in Aeronautics, vol. 15, no. 255, Sept. 4, 1918, pp. 216-223, 15 figs.; Engineer, vol. 126, no. 3271, Sept. 6, 1918, pp. 1914-196; 9 figs.; Aviation, vol. 5, nos. 6 and 7, Oct. 15, 1918, pp. 357-360, 10 figs., and Nov. 1, 1918, pp. 429-433, 13 figs.

FRENCH AEROPLANES. The French A. R. Biplane with 190-hp. Renault Motor. Flight, vol. 10, no. 38, Sept. 19, 1918, pp. 1053-1057, 12 figs. Description of machine (translated from German paper). Also in Aviation, vol. 5, no. 7, Nov. 1, 1918, pp. 423-424, 7 figs.

GERMAN AEROPLANES. German Airplane, Albatros D. V. (Avion allemand Albatros D. V.) L'Aérophile, year 26, nos. 13, 14, July 1-15, 1918, pp. 203, 3 figs. Scheme and dimensions.

New German Airplanes (Nouveau avions allemands). L'Aérophile, year 26, nos. 13, 14, July 1-15, 1918, pp. 199-201, 6 figs. General characteristics of Pfalz D III, Fokker D VII, Halberstadt CII, and Riesenflugzeuge.

Report on the A. E. G. Armored Aeroplane, J. G. Weir. Aeronautics, vol. 15, no. 255, Sept. 4, 1918, pp. 212-214, 12 figs. Issued by Tech. Department, Aircraft Production, Ministry of Munitions. Also published in Engineer, vol. 126, no. 3271, Sept. 6, 1918, pp. 206-207, 11 figs.; Aviation, vol. 5, no. 6, Oct. 15, 1918, pp. 367-368, 3 figs.; Flight, vol. 10, no. 35, Aug. 29, 1918, pp. 969-972, 15 figs.

Report on the Hannoveraner Biplane. Aeronautics, vol. 15, no. 256, Sept. 11, 1918, pp. 239-245, 24 figs. Particulars of enemy machine. By Technical Department, Aircraft Production, Ministry of Munitions.

Report on Two-Seater Rumpler Biplane, G.117. Aeronautics, vol. 15, no. 256, Sept. 11, 1918, pp. 245-249, 22 figs. Details of enemy machine using 260-hp. Mercedes engine. By Technical Department, Aircraft Production, Ministry of Munitions. Also published in Flight, vol. 10, no. 37, Sept. 12, 1918, pp. 1025-1030, 25 figs.

Some Fokker "Milestones." Flight, vol. 10, no. 35, Aug. 29, 1918, pp. 966-967, 8 figs. Development of Fokker firm since outbreak of war.

The German Airplane, Pfalz D. III. (L'Avion allemand Pfalz D. III.) L'Aérophile, year 26, nos. 13, 14, July 1-15, 1918, pp. 193-198, 6 figs. Details of planes, tail, fuselage, motor and armament.

The Pfalz Single-Seater Fighter (II). Automotive Ind., vol. 39, nos. 11 and 12, Sept. 12 and 19, 1918, pp. 462-463, 3 figs., and 503-505, 6 figs. Mounting of tail plane, tail skid, vertical fin and rudder and construction of these parts. Sept. 19: Seating arrangement — aileron, elevator, rudder controls; landing gear. (From Flight.) Also published in Engineer, vol. 126, no. 3274, Sept. 27, 1918, pp. 270-272, 16 figs.

The Zeppelin Giant Airplane. Aviation, vol. 5, no. 6, Oct. 15, 1918, pp. 365-367, 6 figs. Wire-bracing; ailerons; vertical fins and rudders; internal arrangements; armament; undercarriage, controls; weight items. (Concluded)

MODEL AIRPLANES. Model Aeroplane Building as a Step to Aeronautical Engineering. Aerial Age, vol. 8, no. 4, Oct. 7, 1918, p. 181, 10 figs. Construction of a 20-ft. glider. (Continuation of serial.)

Model Aeroplanes (XV), F. J. Camm. Aeronautics, vol. 15, no. 253, Aug. 21, 1918, p. 176, 1 fig. Rudiments of aerofoil theories. (To be continued.)

PERFORMANCE, AEROPLANE. Airplane Performance Determined by Engine Performance, G. B. Upton. Jl. Soc. Automotive Engrs., vol. 3, no. 4, Oct. 1918, pp. 275-279, 3 figs. Curves showing altitude against engine speed for various efficiencies and speed ratios, also curves showing engine and propeller power at different altitudes and ceiling height for conventional and theoretical constant-power engine.

PROPELLERS. Air Propeller Performance and Design by the Specific Speed Method, M. C. Stuart. Practical Engr., vol. 58, no. 1648, Sept. 26, 1918, pp. 148-150, 3 figs. Rotational speed and diameter of propeller being expressed in terms of power and forward velocity, a direct method of treatment obtained. (To be continued.)

British Advisory Committee Report for 1917-1918. Aviation, vol. 5, no. 6, Oct. 15, 1918, pp. 368-370. Account of experimental work at National Physical Laboratory in aerodynamics and strength of construction.

The National Physical Laboratory Report, 1917-1918. Aeronautics, vol. 15, no. 255, Sept. 4, 1918, pp. 226-227. References to aeronautical work.

RESEARCH. Third Annual Report of the National Advisory Committee on Aeronautics. Aerial Age, vol. 8, no. 4, Oct. 7, 1918, pp. 174-175. Board of war inventions in aeronautics; metric system for drawings and calculations; technical reports; general problems and activities. (Continuation of serial.) Also published in Aeronautics, vol. 15, no. 256, Sept. 11, 1918, pp. 250-253.

STRESSES IN STRUCTURE. Stresses in Airplane Ribs, Irving H. Cowdrey. Aviation, vol. 5, no. 7, Nov. 1, 1918, pp. 425-428, 5 figs. Transverse testing under non-uniformly distributed load with special application to airplane wing ribs. Before Am. Soc. for Testing Materials.

The Stresses in a Fusilage in Torsion, H. A. Webb. Aeronautics, vol. 15, no. 250, July 31, 1918, pp. 105-106, 4 figs. Method of approximation based on assumption that wires are initially unstretched and torsion is carried entirely by wires, the struts and longerons merely holding them in position.

TRAJECTORY AEROPLANE. Trajectory of Airplane Equipped with a Fuselage. (Trajectoire de l'aéroplane à nacelle), L. Farand. L'Aérophile, year 26, nos. 13 and 14, July 1-15, 1918, pp. 204-208, 12 figs. Mathematical computation of hodograph based on assumption that the angle of the planes with the trajectory remains constant and that the force of propulsion remains always horizontal.

AIR MACHINERY

AIR SUPPLY TO BOILER ROOM. The Air Supply to Boiler Rooms, Richard W. Allen. Engineer, vol. 126, no. 3271, Sept. 6, 1918, pp. 198-199, 10 figs. Considering chiefly air supply to closed stokeholds. Paper before Inst. of Naval Architects March, 1918.

BLOWERS. Blower for Water-Tube Boiler Plant at Bristol Electricity Works. Engineering, vol. 106, no. 2744, Aug. 2, 1918, pp. 126, 13 figs. Drawings of boiler and blower arrangements.

COMPRESSED AIR. The Use of Compressed Air (l'emploi de l'air comprimé), M. C. F. Bernard. L'Echo des Mines, no. 2594, Oct. 6, 1918, pp. 507-508. Disposal of water of condensation collecting in compression chamber and conduits.

WIND POWER. Some Long Island Windmills, Edward P. Buffet. Am. Mach., vol. 49, no. 16, Oct. 17, 1918, pp. 725-729, 10 figs. Illustrated description of century-old grist mills.

Utilization of Wind Power (Om Udnyttelse af Vindkraften), H. C. Vogt. Ingeniren, year 27, no. 79, Oct. 2, 1918, pp. 521-522.

BRICK, CLAY AND STONE

ABRASION TEST. Abrasion Test for Mineral Aggregates, H. H Scofield. Good Roads, vol. 16, no. 12, Sept. 21, 1918, pp. 108 and 110. Suggested modification of Deval test for stone, gravel and similar materials.

BRIDGES

CONCRETE BRIDGES. Recommended practice for Concrete Bridge Construction. Cement & Eng. News, vol. 30, no. 8, Aug. 1918, pp. 30-34, 2 figs. General specifications, prepared by engineers of Portland Cement Assn., based on recommendations of committee on Bridges of Am. Concrete Inst. and on parts of Bul no. 10 of Illinois State Highway Department, a Manual for County Superintendents of Highways, Resident Engineers, and Inspectors.

Recommended Practice in Design and Construction of Permanent Highway Bridges of Concrete and Steel, John W. Towle. Mun. & County Eng., vol. 55, no. 4, Oct. 1918, pp. 144-145. Features of three types: flat slabs or box culverts, girder with two or more heavy stringers, circular or elliptical bridge.

Standard Practice in Concrete Bridge Construction, H. Colin Campbell. Eng. & Cement World, vol. 13, no. 6, Sept. 15, 1918, pp. 11-16, 6 figs. Considerations to determine suitable type of highway bridge for a given location.

Old Bridges. Investigating Old Bridges for Heavier Loading, C. F. Loweth. Ry. Age, vol. 65, no. 17, Oct. 25, 1918, pp. 741-745, 1 fig. Abstract of paper at convention of Am. Ry. Bridge & Building Assn., Chicago, Oct. 1918.

Quebec Bridge. The New Quebec Bridge. Engineering, vol. 106, no. 2750, Sept. 13, 1918, pp. 237-281, 23 figs. A fully illustrated account.

Trunnion Bearing. Reparing a Bascule Bridge Trunnion Bearing. Ry. Age, vol. 65, no. 18, Nov. 1, 1918, pp. 771-772, 3 figs. To insert a new bushing it was necessary to lift an entire span, weighing about 800 tons.

BUILDING AND CONSTRUCTION

Dams. Dams for $20,000,000 Miami Conservancy. Contracting, vol. 7, no. 9, Nov. 1, 1918, pp.276-277, 5 figs. Construction of earth embankments containing up to 4,000,000 yd. with excavated material transported on cars, dumped into sumps, and pumped to place.

Foundations. Reconstructing Foundations of Philadelphia City Hall (II). Contracting, vol. 7, no. 9, Nov. 1, 1918, pp. 271-272, 3 figs. Replacement of rubber footings by heavy concrete sectional construction built in sheeted pits 6 ft. long.

Integral Forms. Concrete Construction with Integral Forms. Contracting, vol. 7, no. 9, Nov. 1, 1918, pp. 273-274. Utilization of elements of permanent structure eliminating steel and wood temporary forms.

Masonry Building. Guatemala Earthquakes Destroyed All Masonry Buildings, Edward Stuart. Eng. News-Rec., vol. 81, no. 14, Oct. 3, 1918, pp. 623-626, 8 figs. Wood and concrete frames stood shocks well; wrecked sanitary services to be rebuilt under direction of Red Cross engineers.

Piers. Building B. & O. R. R., Pier No. 9, Baltimore. Contracting, vol. 7, no. 9, Nov. 1, 1918, pp. 274-275, 3 figs. Replacement of 160 x 850 ft. burned pier and freight house.

The Furness-Withy Company Reinforced Concrete Pier at Halifax, N.S., A. F. Dyer. Conctract Rec., vol. 32, no. 35, Aug. 28, 1918, pp. 692-695, 5 fig. Work being done in construction of a pier 590 ft. long by 90 ft. wide, carrying a single storey shed 514 ft. by 70 ft.

Shops. New Shop of Standard Steel Car Company. Ry. Rev., vol. 63, no. 13, Sept. 28, 1918, pp. 465-467, 9 figs. Designed for rapid erection to me t war needs; cost of construction; details of plans.

Storage Tanks. Advice on Oil-Storage Tanks. Petroleum Rev., vol. 39, no. 836, July 27, 1918, p. 60. Manufacture of reinforced concrete tanks: expansion joints. From U. S. Bureau of Mines Bul. (Concluded.)

Tanks. Tank Construction (XXI), Ernest G. Beck. Mech. World, vol. 64, no. 1651, Aug. 23, 1918, pp. 90-91, 5 figs. Formulae and diagrams: side walls of rectangular tanks.

Wind Pressure, Chimneys. Wind Pressure on Tall Chimneys. Engineering, vol. 106, no. 2752, Sept. 27, 1918, pp. 334-336, 8 figs. Observations of Professor Omori on movement to which top of a chimney is subjected by wind pressure; chimney in question is 567 ft. high.

CEMENT AND CONCRETE

Cold Weather. Placing Concrete in Cold Weather. Ry. Signal Engr., vol. 15, no. 216, Sept. 1918, pp. 329-330. Rules for preparing concrete mixtures and means to protect them when freshly placed during periods of cold weather. (Portland Cement Assn. of Chicago.)

Disintegration

See Harbor Works

Harbor Works. Reinforced Concrete in Harbor Works, A. F. Dyer. Can. Engr., vol. 35, no. 13, Sept. 26, 1918, pp. 277-284 and 289, 11 figs. Causes of disintegration or disruption and means of preventing them; description of two structures. Before Eng. Inst. of Can.

Paving. Concrete for Level Slope Paving. Eng. & Cement World, vol. 13, no. 6, Sept. 15, 1918, pp. 21-22, 9 figs. Results obtained in 500,000 acres reclamation project in Little River Drainage District, Mo.

Piles. Supporting Power of Concrete Pedestal Piles, Henry W. Young. Eng. & Cement World, vol. 13, no. 6, Sept. 15, 1918, pp. 17-19, 3 figs. Methods of forming and results achieved in various soil conditions.

Sections. A Note on the Determination of Excentrically Loaded Concrete Sections (Beitrag zur Bestimmung exzentrisch belasteter Eisenbetonquerschnitte) H. Paeplou. Armierter Beton, year 11, no. 5, May 1918, pp. 90-96, 2 figs.

Determination of Cross Sections of Concrete under One-Sided Compression or Tension with or without Consideration of Tensile Strength of the Concrete (Bestimmung einseitig gedrückler oder gezogener Eisenbetonquerschnitt. ohne und mit Berucksichtigung der Betonzugfestigkeit), E. Elwitz. Beton ue Eisen, year 17, nos. 7-8, May 4, 1918, pp. 84-86. 36 figs.

Setting Process. The Mechanism of the Setting Process in Plaster and Cement, Cecil H. Desch. Sci. Am. Supp., vol. 86, no. 2232, Oct. 12, 1918, pp. 234-235. Attempts to examine two hypothesis and evidence induced in their support, and to indicate the nature of observed discrepancies.

CHEMICAL TECHNOLOGY

Alcohol. Manufacture of Ethyl Alcohol from Wood Waste. Engineer, vol. 126, no. 3271, Sept. 6, 1918, pp. 204-205, 1 fig. Historical resumé; description of present process; economic considerations; uses of ethyl alcohol.

Ammonia. Enormous Quantities of Ammonia Soon Available. Gas Age, vol. 13, no. 7, Oct. 1, 1918, pp 317-318. Prospect of yield from Government synthetic plants.

The Oxidation of Ammonia, J. R. Partington. Jl. Soc. Chem. Ind., vol. 37, no. 17, Sept. 16, 1918, pp. 337R-338R, 1 fig. Form of technical converter unit for oxidation by passing ammonia and air over a heated catalyst.

Ammonium Sulphate. The New Plant at the Varta Gas Works in Stockholm, Sweden, for the Production of Ammonium Sulphate and Spirit of Salmiac (Die Neuanlagen auf dem [illegible]), O. Thümmel, Journal für Gasbeleuchtung, year 61, nos. 18 and 19, May 4 and 11, 1918, pp. 205-210, [illegible]

Atomic Weights. Revisions of Atomic Weights in 1917 (Les révisions de poids atomiques en 1917), E. Moles. Journal de Chimie Physique, vol. 16, no. 3, Sept. 16, 1918, pp. 350-376. Methods followed and results obtained in each of ten reports; list of publications on subject published in that year.

Boiling Points. Considerations on the Causes for Abnormal Boiling Points. (Considérations sur les causes des points d'ébullition anormaux). A. Berthoud. Jl. de Chimie Physique, vol. 16, no. 3, Sept. 15, 1918, pp. 245-278. Analytical research of influence of molecular association in causing the existence of abnorma boiling points with remarks on Forcrand's experiments with water, ammonia and fluorhydric acid.

Copper Carbonates. The Basic Carbonates of Copper, H. Barratt Dunncliff and Sudarshan Lal. Jl. Chem. Soc. vols. 113 and 114, no. 671, Sept. 1918, pp. 718-722. Examination of a number of samples of commercial copper carbonate showing that the statement that it has same composition as malachite is erroneous; attempt to prepare a basic copper carbonate of approximately constant composition from pure materials.

Ethylene. Contribution to the Revision of the Atomic Weight of Carbon: Determination of the Density of Ethylene (Contribution à la revision du poids atomique du carbone: détermination de la densité normale du gaz éthylène), T. Batnecas. Journal de Chimie Physique, vol. 16, no. 3, Sept. 16, 1918, pp. 322-349, 5 figs. Four methods of preparing ethylene; physical purification of gas; determination of density; results obtained.

Explosives. Methods for Routine Works in the Explosives Physical Laboratory of the Bureau of Mines, S. P. Howell and J. E. Tiffany. Department of the Interior, Bureau of Mines, tech. paper 186, 63 pp., 15 tables. Precautions to be observed in storing, handling, and testing explosives; physical examination tests with ballistic pendulum; tests in gas-and-dust gallery; rate of detonation by Mettegang recorder; conversion tables used in explosives work; list of publications.

Gasoline. Petrol From Your Own Well Gas. Petroleum World, vol. 15, no. 216, Sept. 1918, pp. 371-378, 4 figs. Facts about recovery of gasoline from natural gas by compression and refrigeration; plan of typical direct-connected compressor plant, coils and tower.

Substitute for Lamp Gasoline (Lampenbenzinersatz), A. Krieger. Journal für Gasbeleuchtung, year 61, no. 19, May 11, 1918, pp. 220-221, 1 fig.

Glass. The Significance of Glass-Making Processes to the Petrologist, N. L. Bowen. Sci. Am. Supp., vol. 86, no. 2231, Oct. 5, 1918, p. 221, 1 fig. Processes of manufacturing optical glass and factors making for inhomogeneity in glass. From Jl. of Wash. Academy of Sci.

Hydrocarbons from Coal. The Ractions of Carbonization. Times Eng. Supp. no. 258, Oct. 1918, p. 205. Conclusions drawn from experimental work in preparation of hydrocarbons from coal.

Hypophosphates. On the Preparation of Hypophosphates, R. G. Van Name and Wilbert J. Hull. Am. Jl. of Sci., vol. 46, no. 274, Oct. 1918, pp. 587-590, 1 fig. Apparatus for preparation by oxidation of yellow phosphorus.

Leather. Recent Developments in Leather Chemistry, H. R. Proctor. Jl. Roy. Soc. of Arts, vol. 66, no. 3440, Oct. 25, 1918, pp. 747-753. Preparing skins or hides for tannage and account of some treatments.

Naphthalene. Determination of Naphthaline in Tars and Tar Oils, Oscar Knublauch. Gas Jl., vol. 143, no. 2888, Sept. 17, 1918, pp. 530-531. Adaptation of author's method of estimating naphthalene by direct titration of picrate with standard alkali to analysis of tars and tar oils. (From Journal für Gas Beleuchtung, vol. 61, pp. 134-145).

Description of Direct Determination of Naphthalene in Tar Oil and Raw Naphthalene by the Acid Method (Eine Methode der direkten Naphthalin-Bestimmung in Teer, Teerol und Rohnaphthalin durch Uberführen in Pikrat), Knublauch. Journal für Gasbeleuchtung, year 61, no. 12, Mar. 23, 1918, pp. 134-137.

Nitrogen Oxide. Contribution to the Study of the Velocity of Oxidation of Nitrogen Oxide (Contribution à l'étude de la vitesse d'oxydation du gas oxyde d'azote), E. Briner and E. Fridori. Journal de Chimie Physique, vol. 16, no. 3, Sept. 12, 1918, pp. 279-321, 6 figs. Experimental investigation based on refrigeration of gaseous mixture.

Peat. Sulphite Peat Coal, R. W. Strehlenert. Jl. Am. Peat Soc., vol. 11, no. 4, Oct. 1918, pp. 269-274. Experiments in preparation of coal from residues of paper sulphite process. From Pulp & Paper Mag. of Can.

Petroleum. Petroleum under the Microscope, James Scott. Petroleum World, vol. 15, no. 216, Sept. 1918, pp. 378-379, 3 figs. Forms of carbon and microstructure of soot. (Continuation of serial.)

Rubber. Apparatus for Drying or Heat Treatment of Rubber. India-Rubber Jl., vol. 56, no. 14, Oct. 5, 1918, pp. 5-6, 1 fig. Apparatus in which material or articles to be treated are adapted to be supported by rotary member which conveys articles through oven.

Gauging the Degree of Vulcanization. India Rubber Jl., vol. 56, no. 14, Oct. 5, 1918, p. [illegible]. [illegible] discontinuous supply of vulcanizing medium when rubber is exposed to an extent corresponding with degree of vulcanization desired.

Substitutes in Germany. Eng. Rev., vol. 32, no. 3, Sept. 16, 1918, pp. 71-72. Graphite economies and substitutes: regenerated rubber and srubtitutes: fibrous materials. (Continuation of serial.)

Synthetic Rubber. Can. Machy., vol. 20, no. 14, Oct. 3, 1918, p. 400. Substitute prepared in Germany from long continued boiling of isoprene and dimethylbutadienne.

The Rubber Industry, J. Bretland. Sci. Am. Supp., vol. 86, no. 2229, Sept. 21, 1918, pp. 178-179. Brief account of recent scientific methods, From Jl. Roy, Soc., of Arts.

Silicic Acid Gels. Silicic Acid Gels, Harry N. Holmes. Jl. Phys. Chem., vol. 22, no. 7, Oct. 1918, pp. 510-519, 4 figs. Information for preparing special silicic acid gels and report of work on effect of high concentrations of acid mixed with sodium silicate and comparative effect of weak and strong acids on silicic acid

Sulphuric Acid. Some Data on the Contact Process of Sulphuric Acid Manufacture of the Association of Chemical Factories of Mannheim (Beitrage zur Kenntniss des Kontaktschwefelsaureverfahrens des Vereins Chemischer Fabriken in Mannheim), Hugo Ditz and Frank Kauhauser. Zeitschift für Angewandte Chemise, year 31, no. 63, Aug. 6, 1918, pp. 149-150.

Water Gas. Discussion of the Chemical Phenomena Underlying the Formation of water Gas (Ueber die chemischen Grundlagen der Wassergasbildung). Zeitschrift fur Angewandte Chemie, year 31, no. 57, July 16, 1918, pp. 137-139

COAL INDUSTRY

Coke. On the Formation of Coke (Sur le formation de coke), Georges Charpy and Marcel Godchot. Comptes Rendus des Séances de l'Académie des Sciences, vol. 167, no. 9, Aug. 26, 1918, pp. 322-324. Report of experimental work in coking carbon mixtures of different qualities.

Lignites. The Briquetting of Lignites, R. A. Ross. Iron & Steel of Can., vol. 1 no. 9, Oct. 1918, pp. 357-358. Feasibility of meeting requirements in Saskatchewan and Manitoba by utilizing prepared lignites and sub-bituminous coal.

Panel System of Mining. Suggestions for Improved Methods of Mining Coal on Indian lands in Oklahoma, J. J. Rutledge and D. Harrington. Department of the Bureau of Mines, tech. paper, 154, 36 pp., 12 figs. Applicability of different modifications of the panel system ot mining coal; list of publications on coal mining.

Screens. A New Type of Screen, M. Raymond. Coal Age, vol. 14, no. 13, Sept. 26 1918, pp. 589-590, 3 figs. Modified form of American system of rope transmission for coal screening.

ELECTRICAL ENGINEERING

Air Gaps. The Reluctance of an Air Gap Having Slots in Both Opposing Surfaces F. W. Carter. Elecn., vol. 81, no. 2103, Sept. 6, 1918, pp. 400-401, 3 figs. Comment on article by S. P. Smith appearing in Elecn. Feb. 8, 1918.

Alternatives. Armature Reaction and Wave Form of a Single Phase Generator (in Japanese). G. Shimizu. Denki Gakkwai Zassihi, no. 362, Sept. 10. 1918.

Synchronising of Alternators, E. Styff. Elecn., vol. 81, no. 2098, Aug. 2, 1918, pp. 290-291, 4 figs. Abstract of article in Electro-technische Zeitschrift.

Cables. Causes of Corrosion of Underground Electric Cables (Kabelzerstörungen in der Erde). C. Michalke. Dingler's Polytechnisches Journal, vol. 333, no. 6, Mar. 23, 1918, pp. 43-45. A somewhat general discussion.

Measurement of Power Losses in Dielectrics of Three-Conductor High-Tension Cables, F. M. Farmer. Elecn., vol. 81, no. 2098, Aug. 2, 1918, pp. 288-289, 3 figs. Describing methods used at electrical testing laboratories for measuring diaelectric power losses in 10-ft. samples of three-conductor cables subjected to three-phase potential; results given for two specimens of cable, one having low and other high power loss in diaelectric.

Central Stations. Reconstruction of a Two-Phase Station. Elec. World, vol. 72, nos. 14 and 17 Oct. 5 and 26, 1918, pp. 644-646, 7 figs., and 788-790, 2 figs. How some problems made necessary by rapid local developments were handled by an Iowa company. Description of furnace equipment and efficiency instruments installed in plant. (First article.)

Conductivity. A New Method for the Determination of Conductivity, Edgar Newbery. Jl. Chem. Soc., vols. 113 and 114, no. 671, Sept. 1918, pp. 701-707, 2 figs. Apparatus in which direct current is used and disturbing effects of polarization at electrodes are eliminated; values obtained for specific conductivity of solutions in mhos. at 25 deg.

Conductors, Heating of. Experiments on Heating of Conductors, Henry C. Horstmann and Victor H. Tousley, Elec. World, vol. 72, no. 15, Oct. 12, 1918 pp. 690-693, 1 fig. Application of tables which show allowable sizes of wire to use with intermittent loads such as are created by skip hoist and crane motors; economy possible in choice of conductor. (Second article.)

D. C. Motors. Operation of Direct-Current Motors in Parallel or Series, Gordon Fox. Power, vol. 48, no. 19, Nov. 2, 1918, pp. 666-568, 6 figs. Considerations leading to use of two motors in parallel are discussed.

Discharges Disruptive

See Sparks

Frequency Changers. Load Division Between Synchronous Frequency Changers Opering in Parallel. Quentin Graham. Power, vol. 48, no. 17, Oct. 22, 1918, 3 figs. (Second article.)

Distributing Systems. Electrical Distribution System at Hog Island Shipyard, H. W. Young. Elec. Rev., vol. 73, no. 18, Nov. 2, 1918, pp. 683-685, 5 figs. Extensive distributing system for power and lighting at world's biggest shipyard; circuits largely underground; connected load of 30,000 kw. power and 6,000 kw. lighting.

Inductive Interference. Interference by High Power Lines, H. C. Don Carlos Telephony ,vol. 75, no. 17, pp. 28-30. Features of inductive interference by power lines of practical value to rural telephone companies. Before Can. Independent Telephone Convention.

Induction Motors. The Running and Maintenance of Induction Motors at Collieries, L. Fokes. Colliery Guardian, vol. 96, no. 3014, Oct. 4, 1918, pp. 701-702, 4 figs. Selection of motors; electrical considerations; pressure distribution in a star-connected stator with neutral earth—neutral insulated delta—connected stator; stator windings; type of stator best suited for colliery work.

The Slip-Ring Induction Machine (La machine asynchrome à baques), Marius Lafour. Revue Générale de l'Electricité, vol. 4, no. 9, Aug. 31, 1918, pp. 291-296, 19 figs. Study of devices proposed by various inventors to increase power factor or regulate speed.

Insulation. The Protection of Electrical Apparatus, P. M. Lincoln. Elec. Jl., vol. 15, no. 9, Sept. 1918, pp. 346-348. Review of methods by which integrity of electrical insulation may be secured and permanently assured.

Installation and Care of Large Electrical Apparatus for Steel Mills, O. Needham. Elec. Jl., vol. 15, No. 9, Sept. 1918, pp. 333-336, 2 figs. Suggestion in regard in insulation protection, handling, starting and operation of large motors.

Japanese Electrical Exhibition. Big Japanese Electrical Exhibition, A. E. Bryan. Elec. News, vol. 27, no. 20, Oct. 15, 1918, pp. 25-27. General description of exhibits held by Japanese Elec. Soc. to show possible markets and competition to be expected after the war.

Magnetism. Normal State and Polarization in Ferro-Magnetic Materials (Normülzustand und Polarization in Ferromagnetikum), Edy Velander. Reprint from Archiv für Elektrotechnik, vol. 6, no. 12, June 22, 1918, pp. 409-437, 32 figs.

Note on a Property of Ferromagnetism (Sur une propriété du ferromagnetisme), Pierre Weiss. Revue Générale de l'Electricité, vol 4, no. 8, Aug. 24, 1918,pp. 257-258, 2 figs. Magnetization curves of hickel at various temperatures near the Curie point. (From Comptes des Séances de l'Académie de Sciences, July 8.)

Magneto. Ignition Magneto Construction,H.R. Van Deventer. Jl. Soc.Automotive Engrs., vol. 3, no. 4, Oct. 1918, pp. 257-265, 28 figs. Review of features of magneto construction and adjustment.

On the Potential Generated in a High-Tension Magento, E. Taylor Jones. Lond. Edinburgh & Dublin Phil. Mag., vol. 36, no. 212, Aug. 1918, pp. 145-169, 6 figs. Theoretical study of phenomena taking place after contract are separated and especially of manner in which secondary potential rises and in which its value depends upon the properties of the circuits.

Magnets. An Instrument for Testing Permanent Magnets. Automotive Ind., vol. 39, no. 12, Sept. 19, 1918, p. 505, 1 fig. Designed for testing total flux and coercive force.

Outdoor Apparatus. Housing of Outdoor Electric Apparatus, Roger L. Evans. Quarterly of Nat. Fire Prevention Assn., vol. 12, no. 2, Oct. 1918, pp. 155-156, 1 fig. Objections to use of corrugated iron structures.

Outdoor Distribution Substation in War Times, R. E. Conningham. Elec. World, vol. 72, no. 14, Oct. 5, 1918, pp. 642-643, 3 figs. Three-phase transformers with automatic poletop oil switches in primary; innovation found suitable under certain conditions.

Paper, Inductive Capacity. Specific Inductive Capacity of Paper, H. C. P. Weber and T. C. Mackay, Elec. Rev., vol. 73, no. 14, Oct. 5, 1918, p. 525, 2 figs. Effect of temperature and impregnation upon capacity. From Jl. Franklin Inst., Sept. 1918.

Polyphase Motors. Protection of Polyphase Motors with Primary Resistor Type Self-Starters. Jl. of Elec., vol. 41, no. 9, Nov. 1, 1918, pp. 407-408, 1 fig. Connections for typical resistor to give balanced starting conditions.

Rectifiers. Mercury Vapor Rectifier (Von Quecksilberdampf-Gleichrichter). Schweizerische Bauzeitung, vol. 72, no. 13, Sept. 28, 1918, pp. 117-120, 13 figs.

Remote Control. The Remote Control of Motor Driven Pumps and Compressors F. M. Nourse, Mun. & County Eng., vol. 55, no. 4, Oct. 1918, pp. 133-136, 14 figs. Operation of automatic motor starter.

Resistance. Direct Calculation of the Resistance of Any Number of Conductors Connected in Parallel (Calcul direct de la resistance d'un nombre quelconque de conducteurs associés en parallèle), E. Haudie. Revue Générale de l'Electricité, vol. 4, no. 10, Aug. 31, 1918, p. 297, 2 figs. Proposes improvement in methods shown in issues of Mar. 23, and June 29.

One the Rate of Change at 100 deg. cent. and at Ordinary Temperatures in the Electrical Resistance of Hardened Steel, E. D. Campbell, Iron & Steel Inst. Sept. 12-13, 1918, advance copy, paper 2, 6 pp., 2 figs. Results obtained with bars 6 millimeters square and 15 cm. long which were suspended and kept for an hour in an electrically heated furnace before being quenched in a large volume of water maintained below 10 deg. cent.

Resonance Transformer Circuits. The Power Factor in the Resonance Transformer Circuit, P. Baillie. Wireless World, vol. 6, no. 67, Oct. 1918, pp. 376-380, 3 figs. Curves showing surtension (L /R) against cos *a* for different values of $\bar{K}$ (number of semiperiods between two consecutive sparks), plotted from values computed from the formulæ derived in article.

Rotary Converters. The Design Conctruction and Use of Rotary Converters, C. Sylvester. Electricity, vol. 32, no. 1453, Sept. 13, 1918, pp. 479-480, 7 figs. Explanations of author's experiments illustrating principle of operation of converters. (To be continued.)

Sparks. Photographs of Electric Spark (Figures de la décharge électrique sur plaques photographiques), Usaboro Toshida, Revue Générale de l'Electricité, vol. 4, no. 8, Aug. 24, 1918, pp. 253-256, 10 figs. Interpretation of formation of Lichtenberg figures on photographic plates, from experiments under various conditions (From Memoirs of the College of Science, Kyoto Imperial Univ., Mar. 1917.)

STORAGE BATTERIES. Thermostatic Generator Control Now Proves Success. Automotive Ind., vol. 39, no. 11, Sept. 12, 1918, p. 460, 3 figs. Saving battery life by compensation for atmospheric temperature.

SUBSTATIONS. The Automatic Substation Has Come to Stay. Walter C. Slade. Elec. Ry. Jl., vol. 52, no. 15, Oct. 12, 1918, pp. 651-654. Outlining present status of automatic substation.

(*See also Outdoor Apparatus.*)

TRANSFORMERS. The Economical Loading of Transformer Banks. Elec. World, vol. 72, no. 16, Oct. 19, 1918, pp. 737-738, 2 figs. Giving curves which make it possible to keep most economical number of transformers in service.

Siemens-Blake Automatic Fire Extinguisher for Use in Transformer Installations (Extincteur d'incendie automatique pour cabines de transformateurs, système Siemens et Halske.) Génie Civil, vol. 73, no. 7, Aug. 17, 1918, pp. 135-136, 1 fig. Sends a large volume of carbon dioxide, gives warning and indicates place where fire started. (From Elecktrotechnische Zeitschrift, May 23).

Temperature Indicator for Transformer Winding, V. M. Montsinger, and A. T. Childs. Elecn., vol. 81, no. 2106, Sept. 27, 1918, pp. 450-451, 2 figs. Abstract of article in Genl. Elec. Rev.

TRANSMISSION LINES. Transmission-Line Construction of Duquesne Light Company, Thomas R. Hay. Elec. Rev., vol. 73, no. 17, Oct. 26, 1918, pp. 643-646, 5 figs. Difficulties met with in building a 66,000-volt line through a mountainous region.

TROUBLE LOCATION. Tests for Locating Armature Trouble. Power Plant Eng., vol. 22, no. 21, Nov. 1, 1918, pp. 881-882, 3 figs. All common armature defects detected by one-man bar to bar and ground tests with voltmeter and bank of lamps.

WIRING. Insuring Against Disagreements over Wiring. Elec. World, vol. 72, no. 16, Oct. 19, 1918, pp. 735-737, 4 figs. Forms of contracts used by United Illuminating Co. of Bridgeport, Conn.

ENGINEERING MATERIALS

AEROPLANE FABRICS. International Aircraft Standards. Aeronautics, vol. 15, no. 253, Aug. 21, 1918, pp. 173-175, 1 fig. Specifications for unmercerized cotton aeroplane fabric (grade A); specifications for mercerized cotton aeroplane fabric (grade B); specifications for unmercerized cotton aeroplane fabric (grade B).

ALUMINUM BRONZE. Aluminum Bronzes (Los bronzes de aluminio), Jean Escard. Ravista de Obras Publicas, year 66, no. 2244, Sept. 26, 1918, pp. 485-492. Their properties, manufacture and industrial utilization.

Aluminum Bronze as an Engineering Material, Charles Vickers. Machy., vol. 25, no. 2, Oct. 1918, pp. 135-136. Difficulties in casting; use and characteristics; composition; hightensile aluminum bronzes.

ASPHALT. Standardization of Required Consistency for Asphalt, J. R. Draney. Can. Engr., vol. 35, no. 14, Oct. 3, 1918, pp. 309-310. Present variations and needed efficiency.

BEARING METALS. Conservation of Tin in Bronze Bearing Metals, G. H. Clamer. Foundry, vol. 46, no. 315, Nov. 1918, pp. 532-533. Abstract of paper at Inst. of Metals Div. of Am. Inst. of Min. Engrs., Milwaukee, Oct. 1918, Also in Am. Mach., vol. 49, no. 17, Oct. 24, 1918, pp. 773-775.

Some Notes on Babbitt and Babbitted Bearings, Jesse L. Jones. Metal Ind., vol. 16, no. 9, Sept. 1918, pp. 402-404, 5 figs. (Inst. of Metals Division of Am. Inst. of Min. Engrs., Milwaukee, October 1918.)

Brinell tests at progressively increasing temperatures for a lead-base and a tin-base babbitt; process and tool to give accurate and smooth surfaces to bearings.

BOILER PLATES. Causes of Failure on Boiler Plates, Walter Rosenhain and D. Hansen. Can. Machy., vol. 20, no. 14, Oct. 3, 1918, pp. 393-396, 14 figs. Effect of grain growth; alteration of crystalline structure by mechanical deformation; suggested remedies.

COPPER. The Alloys of Copper and Zinc; An Investigation of Some of their Mechanical Properties, F. Johnson. Steamship, vol. 30, no. 352, Oct. 1918, pp. 82-83. Report of Brinnell hardness tests as cast and after annealing and tensile tests after annealing. Before Inst. of Metals.

The Effect of Cold Work on Copper, W. E. Alkins. Engineering, vol. 106, no. 2750, Sept. 13, 1918, pp. 283-295, 4 figs. Effect of progressive cold work upon tensile properties of pure copper. Paper before Inst. of Metals, Sept. 1918.

GUNMETAL. The Influence of Impurities on the Mechanical Properties of Admiralty Gun-Metal, F. Johnson. Steamship, vol. 30, no. 352, Oct. 1918, pp. 83-84. Review of experimental results of other investigators and account of author's experiments. Before Inst. of Metals.

HARDNESS. The Resistance of Metals to Penetration Under Impact, C. A. Edwards. Engineering, vol. 106, no. 2750, Sept. 13, 1918, pp. 285-288, 9 figs. Including a note on hardness of solid elements as a periodic function of their atomic weights. Paper before Inst. of Metals.

PRECAST CONCRETE LUMBER. Precast Concrete Lumber Proves Successful in Mine. Eng. News-Rec., vol. 81, no. 14, Oct. 3, 1918, pp. 627-629, 1 fig. Fire resistivity sought in replacing steel and wood or all-timber construction; costs about twice those of timber.

SAND. Sand and Sandstones, James Scott. Stone, vol. 39, no. 10, Oct. 1918, pp. 464-466, 3 figs. Study of minute structure and composition of sand.

SOLDERS. Solders and Substitutes for Lead-Tin Solders, Charles W. Hill. Metal Ind., vol. 16, no. 9, Sept. 1918, pp. 412-415, 3 figs. Some notes on results of experiments conducted in Research Laboratory of Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

STRENGTH OF MATERIALS. The Strength of Materials, W. Cawthorne Unwin. Times Eng. Supp., no. 528, Oct. 1918, p. 219. Experimental progress in study of mechanical properties of materials, giving brief history of struggle during 18th and 19th centuries to establish the foundations of knowledge of strength of materials and touching on some recent advances in testing machines and methods. Thomas Hawskley lecture.

TOOL STEEL. Tool Steels. Can. Foundryman, vol. 9, no. 8, Aug. 1918, pp. 174-175. Processes followed to insure proper hardness.

FACTORY MANAGEMENT

ELECTRIC MOTORS. Care and Operation of Electric Motors in Factories, Joseph P. Collopy. Elec. Rev., vol. 73, no. 17, Oct. 26, 1918, pp. 648-662, 4 figs. Proper maintenance of special timely value; good motor location important, points on maintenance of direct-current, induction and synchronous motors.

EMPLOYMENT MANAGER. Selecting the Employment Manager, Philip Brasher. Am. Mach., vol. 49, no. 15, Oct. 10, 1918, pp. 677- 678. Requirements of ideal employment manager as seen by author.

The Employment Manager—A New Factor in Industrial Relationship, Edward D. Jones. Am. Gas Eng. Jl., vol. 109, no. 16, Oct. 19, 1918, pp. 361-364. Psychological evolution and present value of this employment. Also in Jl. Engrs. Club of St.Louis, vol. 3, no. 5, Sept.,—Oct,. pp. 292-301.

FACTORY MANAGEMENT. The Basis of Scientific Management, M. H. Potter, Can. Machy., vol. 20, no. 14, Oct. 3, 1918, pp. 397-399. Question of personal in problem of management.

GRAFIC CONTROL OF PRODUCTION. Graphic Production Control, C. E. Knoeppel. Indus. Management, vol. 65, no. 4, Oct. 1918, pp. 284-288, 5 figs. Fifteen laws of control. (Second article.)

Speeding Production by Using Graphic Meters. Elec. World, vol. 72, no. 13, Sept. 28, 1918, pp. 588-589, 6 figs. How a paper products company has installed a system of circuits in order to permit the management to check from excutive office any operation going on with in the plant.

SHIPBUILDING METHODS. Shipbuilding Methods of the "Eagle" Chaser Factory. Eng .News-Rec., vol. 81, no. 18, Oct. 31, 1918, pp. 788-795, 13 figs. Hull erection divided among seven stations; extensive pre-assembly; rivets heated by electric current; launching platform; automatic platform.

TIME STUDIES. Time Studies for Rate Setting on Gisholt Boring Mills, Dwight V. Merrick. Indus. Management, vol. 56, no. 4, Oct. 1918, pp. 289-299 (Fourth article).

WASTE. Possibilities of Salvage and Utilization of Waste, David Currie. Surveyor, vol. 54, no. 1389, Aug. 30, 1918, pp. 99-100. Work being done in U. S.; German methods; possibilities of municipal salvage. (Inst. Cleansing Superintendents.)

FORGING

AXLE FORGING. Shaping the Front Axle Forging on the Nash Motor Car, J. Ledin. Am. Mach., vol. 49, no. 15, Oct. 10, 1918, pp. 679-680, 5 figs. Desscribing design of special bulldozer die for simultaneously performing several distinct operations on automobile front-axle forging.

SHELL FORGING. Organizing for the Production of Forgings, J. H. Rodgers. Can. Machy., vol. 20, no. 14, Oct. 3, 1918, pp. 381-385, 7 figs. Significance of proper forging of shell in subsequent operations; new machine designed for gaging length of billets.

FOUNDRY

CASTING. Casting Grey-Iron Piston Rings by Machinery, Ellsworth Sheldon, Am. Mach., vol. 49, no. 18, Oct. 31, 1918, pp. 783-787, 10 figs. Description of the continuous casting of grey-iron piston rings by a machine in which advantage is taken of the action of centrifugal force upon the molten metal.

ELECTRIC FURNACE. The Electric Furnace in the Steel Foundry, W. E. Moore. Can. Foundryman, vol. 11, no. 9, Oct. 1918, pp. 258-259. Resumé of progress attained during past few years. Before Am. Foundrymen's Assn.

MOLDING. A New Method of Molding Trench Mortar Shell, H.Cole Estep. Foundry, vol. 46, no. 315, Nov. 1918, pp. 523-525, 6 figs. Two castings are made in each flask; jarring machines are used and production is 3[illegible]0 shells per day.

Modern Methods Facilitate Molding of Large Marine Engine Castings. Can. Foundryman, vol. 9, no. 8. Aug. 1918, p. 178. Molding of riple-expansion-engine cylinder casting.

OIL FUEL. Use of Oil Fuel in the Foundry in Urgent Exceptional Circumstances, A. E. Plant. Steamship, vol. 30, no. 352. Oct. 1918, pp. 96-97. Account of installation and operation of foundry in connection with repair shops.

SAND. Bettering the Quality of Foundry Sand Mixtures, Henry B. Hauley. Can. Foundryman, vol. 11, no. 9, Oct. 1918, pp. 243-245, 5 figs. Results obtained in experimental investigation undertaken to determine mixtures of old and new sand best adapted to producing good castings. Before Am. Foundrymen's Assn.

Much Depends on Securing Suitable Sand. Can. Foundryman, vol. 9, no. 8, Aug. 1918, pp. 176-177, 4 figs. Preparation of quartz and limestone sand for use in molds by Montreal company.

STEEL CASTING. Acid vs. Basis Steel for Castings, Edwin F Cone. Iron & Steel of Can., vol. 1, no. 9, Oct. 1918, pp. 361-363. Uses of acid and basic castings; addition of ferro-alloys; question of oxygen; comparative physical properties; German and American steel castings

Government Requirements for Steel Castings, E. R. Swanson. Foundry, vol. 46, no. 315, Nov. 1918, p. 538. Physical properties asked by Ordnance Department for three principal grades of steel castings are discussed

STEEL CASTINGS. Making Ordnance Steel for the Army and Navy, John Howe Hall. Foundry, vol. 46, no. 315, Nov. 1918, pp. 535-537, Problems of steel castings manufacturers in meeting Government specifications; three essential Elements of men's Assn., Milwaukee, Oct. 1918. Also in Iron Age, vol 102, no. 18 Oct. 31, 1918, pp. 1084-86.

FUELS AND FIRING

AIR PREHEATING. Efficiency of Preheated Air. Power Plant Eng., vol. 22, no. 21, Nov. 1, 1918, pp. 876-877, 3 figs. Advantages and systems of introducing preheated air to furnace.

AIR. Evolution of Air from West Virginia Coals. Walter A. Selvig. Power, vol. 48, no. 16, Oct. 15, 1918, pp. [illegible]. Tables of [illegible] temperature of [illegible] West Virginia Coals.

Waste Due to Excess Air in Coal. Coal Age, vol. 14, no. 15, Oct. 10, 1918, pp. 692-693, 1 fig. From report of J. G. Worker, [illegible] Corp. to Gano Dunn, Chairman of Engineering Committee of National Research Council.

Waste Due to [illegible] Combustion of Coal. W. A. Steadly. Power, vol. 48, no. 19, Nov. 2, 1918, pp. 682-683, [illegible] figs. From communication to Chairman of Eng. Committee, National Research Council.

COAL. Calorific Value and Ash Yield of Coal Samples from the Same Seam, T. J. Drakeley. Colliery Guardian, vol. 96, no. 3015, Oct. 11, 1918, pp. 753-791. Paper before Manchester Geological & Min. Soc., Oct. 1918.

COAL STORAGE. Coal Storage Systems for Power Plants. Power Plant Eng., vol. 22, no. 18, Sept. 15, 1918, pp. 750-753, 8 figs. Description of general methods of storing and reclaiming coal.

Checking Stored Coal Temperatures Electrically, Homer W. Popp. Elec. World, vol. 72, no. 16, Oct. 19, 1918, pp. 740, 1 fig. Method of detecting incipient fires in piles of stored coal by means of electrical thermometer.

The Storage of Bituminous Coal, J. H. Stoen. Power Notes, vol. 1, no. 10, Oct. 1918, pp. 1-3, 2 figs. Effect of storage in cost to consumer; ventilating a coal pile.

COMPOSITE FUEL. Artificial Fuel Compositions, Controlled by Industrial Fuel Corporation. Popular Engr., vol. 10, no. 4, Oct. 1918, pp. 24-25, 2 figs. Patented process to utilize accumulations of anthracite culm and slush.

CONTROL OF HEAT. Automatic Heat Control for Coal Saving. Metal Worker, vol. 90, no. 16, Oct. 18, 1918, pp. 437-440. Report prepared by Committee of Heating and Ventilating Engineers by request of United States Fuel Administration. Also in Domestic Eng., vol. 85, no. 2, Oct. 12, 1918, pp. 40-41.

CONTROL METERS, COMBUSTION. Combustion Control Meter. Power, vol. 48, no. 17, Oct. 22, 1918, pp. 599-600, 4 figs. Description of an arrangement of pyrometers developed by Combustion Control Co.

DIAGRAMS OF CONSUMPTION. Production and Consumption Diagrams in Central Stations, Steam and Others. (Diagrammes de production et diagrammes de consommation relatifs aux centrales électrogènes à vapeur et autres), A. Della Riccia. Revue Générale de l'Electricité, vol. 4, no. 10, Aug. 31, 1918, pp. 299-310, 6 figs. Fuel consumption of boilers: empirical diagrams applicable to actual cases; conclusions relative to economical use of fuel. (Concluded.)

FIRING METHODS. Fuel Economy Made Simple, A. Bement. Power, vol. 48, no. 15, Oct. 8, 1918, pp. 524-526. Maintain a hot fire and control rate of combustion by means of draft. Appearance of fire the one comprehensive guide to fireman.

Saving Coal in Boiler Plants, Henry Kreisinger. Department of the Interior, Bureau of Mines, tech. paper 205, 24 pp., 3 figs. Instructions to firemen, engineers and owners of hand-fired plants in taking methods of determining stack losses; significance of flue gas analysis; causes of large excess of air and remedy; losses from incomplete combustion; list of publications on the utilization of coal and lignite.

FUEL CONSERVATION. Industrial Fuel Saving. Times Eng. Supp., no. 528, Oct. 1918, p. 204, 1 fig. Points out possibilities and methods.

On the Coal Economy in Steam Power Plant (in Japanese), H. Sekiguchi. Denki Gakkwai Zasshi, n . 362, Sept. 10, 1918.

GAS FIRING. Installation for Burning Natural Gas under Boiler, J. J. Griffin. Natural Gas & Gasoline Jl., vol. 12, no. 8, Aug. 1918, pp. 285-286, 3 figs. Illustration and description of setting for low-pressure heating boilers.

GRATES. Traveling Grate for Coke and Coke Breeze (Wanderroste für Koksgrus und Koks), Bruno Lepsien. Journal für Gasbeleuchtung, vol. 61, no. 1, Jan. 5, 1918, pp. 3-8, 9 figs. Description of tests with the Pluto grate and the Nyeboe and Nissen Traveling grate for coke breeze, and the Belani and the Steinmuller grates for coke.

HALF-GAS FURNACES. Half-Gas Furnaces with Undergrate Firing (Halbgasofen, mit Unterwindfeuerung), Dingler's Polytechnisches Journal, vol. 333, no. 3, Feb. 9, 1918, pp. 22-23, 6 figs. Desription of several German types of so-called half-gas furnaces, i.e., furnaces in which the fuel is partly gasified and partly brought to complete combustion.

HAND-FIRED FURNACES. Fuel Economy in Hand Fired Boilers. Power Plant Eng., vol. 22, nos. 21 and 20, Nov. 1, and Nov. 15, 1918, and Oct. 15, 1918, pp. 878-880 and 837-839, 4 figs. Abstract of Circular no. 7, "Fuel Economy in the Operation of Hand-Fired Boiler Plants," University of Illinois Engineering Experiment Station. (Second and Third articles.)

Low-rate Combustion in Fuel Beds of Hand-Fired Furnaces, H. Kreisinger, C. E. Augustine, and S. H. Katz. Department of the Interior. Bureau of Mines, tech. paper 139, 54 pp., 19 figs. Extension work reported in technical paper 137 which covered higher rates of combustion of 20 to 180 lb. of coal per sq. ft. of grate per hr., to rates below 20 lb. using the same apparatus and following largely equal methods.

LIGNITE. Burning Lignite with the Mechanical Stoker. Power House, vol. 11, no. 10, Oct. 1918, p. 306. Evaporation test made at the Government of Alberta power station with lignite slack coal.

Lignite Becomes of Importance as a Fuel Resource, S. M. Darling. Am. Gas Eng. Jl., vol. 109, no. 18, Nov. 2, 1918, pp. 415-418. Comparison of carbonized briquets for domestic service with anthracite coal; by-products from lignite. From tech. paper 178 of the United States Bureau of Mines.

LOW-GRADE FUELS. Low-Grade Fuels. Sci. Am. Supp., vol. 86, no. 2229, Sept. 21, 1918, pp. 191-192. Possible method of disposal. From London Times Eng. Supp.

PEAT. Analysis of Canadian Peat. Jl. Am. feat Soc., vol. 11, no. 4, Oct. 1819, pp. 253-268. From samples taken in deposits of Nova Scotia. Prince Edward Island, New Brunswick, Quebec, Ontario and Manitoba.

Inorganic Composition of a Peat and of the Plant from which it was Formed, C. F. Miller. Jl. Am. Peat Soc., vol. 11, no. 4, Oct. 1918, pp. 244-248. Brief description of both products; comparison of composition of peat and saw grass; comparison of losses of three soil-forming materials in their transformation to soils.

The Peat Deposits in Minnesota, E. K. Soper. Jl. Am. Peat Soc., vol. 11, no. 4, Oct. 1918, pp. 227-243, 8 figs. Quantity, quality, and uses to which they are best adapted. Reprinted from Economic Geology, vol. 12, p. 526.

PETROLEUM. Petroleum as Combustible (El petroleo com cumbustible), J. R. Pérez. Revista de la Sociedad Cubana de Ingenieros, vol. 10, no. 9, Sept. 1918, pp. 523-531. Physical and chemical properties; refinement and uses; description of burners.

Unmined Petroleum Supply Limited, Allen Sinsheimer. Automotive Ind., vol. 39, no. 12, Sept. 19, 1918, pp. 491-493, 3 figs. Extent of supply made by United States National Museum following compreheisive survey of situation.

POWDERED COAL. Powdered Coal Substituted for Fuel Oil at Seattle. Elec. Rev., vol. 73, no. 14, Oct. 5, 1918, pp. 529-531, 4 figs. Description of equipment for burning powdered coal at Puget Sound Traction Light & Power Co.'s central heating plant.

Pulverized Coal Tests Conducted at Milwaukee. Elec. Rev., vol. 73, no. 16 and 17, Oct. 19 and 26, 1918, pp. 615 and 658-659, 1 fig. Details of installation in Milwaukee. Efficiency of over 85 per cent obtained. Also in Elec. World, vol. 72, no. 16, Oct. 19, 1918, pp. 744-745; Ry. Rev., vol. 63, no. 17, Oct. 26, 1918, pp. 605-607, 2 figs.; Ry. Age, vol. 65, no. 15, Oct. 11, 1918, pp. 657-660, 2 figs. Power, vol. 48, no. 16, Oct. 15, 1918, pp. 553-559, 4 figs.

SMOKESTACK LOSSES. Apparatus to Measure Chimney Loss and the Elements which Constitute it. (Appareil de mesure de la perte à cheminée et des éléments constitutifs de cette perte.) Marcel Chopin. Comptes Rendus des Séances de l'Académie des Sciences, vol. 167, no. 9, Aug. 26, 1918, pp. 335-338, 2 figs. Suggests instrument registering temperature and amount of carbonic acid.

WASTE GASES. Use of Waste Gases for Steam Generation, J. B. C. Kershaw. Coal Age, vol. 14, no. 13, Sept. 26, 1918, pp. 591-594. Study of progress and records of past few years.

WOOD BURNING. New Wood-Burning Station of Northwestern Electric Company. Elec. Rev., vol. 73, no. 15, Oct. 12, 1918, pp. 573-574, 2 figs. Details of construction and equipment.

FURNACES

ELECTRIC FURNACES. The Development of Stellite, Elwood Haynes, Iron Age, vol. 102, no. 15, Oct. 10, 1918, pp. 886-888, 3 figs. Melting problems solved by Snyder Electric Furnaces which displaced gas-fired crucibles; three furnaces have capacity of over four tons in eleven hours.

GAS OVENS. Experiences with Horizontal Slot Ovens, Henry W. Douglas. Gas Age, vol. 13, no. 7, Oct. 1, 1918, pp. 307-308. Installation of six oven benches containing three ovens each. Before Michigan Gas Assn.

HANDLING OF MATERIALS

STEEL PLANT. Canadian National Steel Plant, W. F.Sutherland. Can.Foundryman, vol. 9, no. 8, Aug. 1918, pp. 169-174, 13 figs. Handling of materials, arrangement of loading platform bins, installation of furnaces and other features.

HEATING AND VENTILATION

ELECTRIC HEATING. Industrial Applications of Electricity, Dwight D. Miller. Elec. World, vol. 72, no. 15, Oct. 12, 1918, pp. 693-695, 2 figs. It is predicted that electric heating load will eventually surpass motor load; convenience of control of electrically generated heat results in improved product and increased production. (First article.)

HOT WATER SERVICE. Standards of Central Station Hot Water Heating Service. Heat. and Vent. Mag., vol. 15, no. 10, Oct., 1918, pp. 31-36. Established by Public Service Commission of Indiana under date Aug. 3, 1918.

PUBLIC SCHOOL VENTILATION. The Movement to Eliminate Mechanical Ventilation in New York City's Public Schools. Heat. & Vent. Mag., vol. 15, no. 10, Oct. 1918, pp. 47-49. Tests by Department of Health of classrooms in twelve rooms is basis for this action. A résumé of the tests.

VACUUM VAPOR SYSTEM. Fuel Saving Heating Systems, Alfred G. King. Domestic Eng., vol. 84, no. 11, Sept. 14, 1918, pp. 390-392 and 423, 4 figs. How a vacuum-vapor heating system is installed and proves effective in fuel economy.

HOISTING AND CONVEYING

BONNER RAIL WAGON SYSTEM. Freight Transportation Without Rehandling. Elec. Ry. Jl., vol. 52, no. 15, Oct. 12, 1918, pp. 658-659, 5 figs. Bonner rail wagon system aims to reduce cost and time of freight haulage by using containers on wheels which do not require warehouse facilities.

CONVEYOR, COAL. A Reciprocating Underground Coal Conveyor, J. F. K. Brown. Coal Age, vol. 14, no. 15, Oct. 10, 1918, pp. 682-684, 2 figs. A conveyor for use in coal beds where inclination is such that cars may be handled only with difficulty.

Cranes. Safety Code for the Operation of Electric Cranes. Power House, vol. 11 no. 10, Oct. 1918, p. 309. Formulated by Iron and Steel Elec. Engrs

GRAIN UNLOADING PLANTS. Portable Pneumatic Grain Unloading Plant. Eng., vol. 128, no. 3266, Aug. 2, 1918, pp. 94-95, 7 figs. Portability the interesting feature, the plant being set upon railway trucks; drawings and description.

Mine Car Dumping. Shipping Facilities at the World's Largest Coal Mine, R. W. Mayer. Coal Age, vol. 14, no. 13, Sept. 26, 1918, pp. 586-588. A mine producing 7,000 tons of coal per day with mine cars dumped at the rate of one every 12 seconds.

Tipple. Valley Camp Coal Co's Tipple at Parnassus, Penn., George S. Jaxon. Coal Age, vol. 14, no. 13, Sept. 26, 1918, pp. 582-585, 11 figs. Designed to make four sizes of coal, a conveyor designed to facilitate cleaning the tracks under the tipple of spillage from the cars after the day's run.

Tractor Trailer, Freight-Trade Handling. Freight Handling by Tractors Found Economical. Eng. News-Rec., vol. 81, no. 16, Oct. 17, 1918, pp. 720-721, 2 figs. Tractor-trailer system replaces hand trucking and reduces costs at large L. C. L. freight station at Chicago.

HYDRAULICS

Artesian Wells. Artesian Wells for Water Supply, with Special Reference to the Artesian Wells of Wisconsin, W. G. Kirchoffer. Mun. & County Eng., vol. 55, no. 4, Oct. 1918, pp. 136-138. Velocity of flow in sandstone formations, mineral content found in ground and artesian waters.

Brazil. Water Power in Brazil. Times Eng. Suppl., no. 528, Oct. 1918, p. 211. Prospects of utilization.

British Empire. Water Powers of the Empire. Can. Engr., vol. 35, no. 18, Oct. 31, 1918, pp. 383-386 and 391-392. Preliminary report of Water Power Committee appointed by Conjoint Board of Scientific Societies of Great Britain. (To be concluded.)

Dams. Calaveras Dam Slide. Report of Government Experts, D. C. Henry and C. H. Swigart. Eng. & Cement World, vol. 13, no. 7, Oct. 1, 1918, pp. 26-28, 2 figs.

Interconnected Plants. Economy of Water Effected by Intercommunication, R. H. Halpenny. Elec. World, vol. 72, no. 18, Nov. 2, 1918. pp. 828-831, 3 figs. Two hydro-electric companies, operating plants on the same stream, are interconnected through a 6000-kva. transformer; difference in load characteristics permits increasing total load with same flow of water.

Niagara Falls. Canada Rushing Huge Niagara Development as a War Conservation Measure. Eng. News-Rec., vol. 81, no. 18, Oct. 31, 1918, pp. 801-805, 9 figs. Report of construction work in digging a 8½ mile canal around falls.

Penstock Pipes. Saving the Waste in Penstock Pipe Design, B. F. Jakobsen. Jl. of Elec., vol. 41, no. 9, Nov. 1, 1918, pp. 413-415, 2 figs. Points out manner of proportioning economically penstock pipes and transmission lines.

Turbines, Hydraulic

(See Waterwheels.)

Water Measurement. Measurement of Water by Means of Cipoletti Weir (Wassermessung mittels des Ueberfalls von Cipoletti) Dinglers Polytechnisches Journal, col. 333, no. 7, April 6, 1918, pp. 58-59. Abstract of a paper by Professor Luedecke in the German publication, Der Kulturtechniker, 1917, no. 4. Derivation of formulæ for determination of water discharge by the Cipoletti Weir. In the present article the logarithmic scale is applied and formulæ are derived.

Water Power. Fundamental Principles in the Development of Water Power, David R. Shearer. Power, vol. 48, no. 16, Oct. 15, 1918, pp. 563-565, 4 figs. Points to be considered in developing water power of a stream; explanation of fundamental calculations.

Water Supplies. The Development of Water Supplies for Rural Communities in Saskatchewan, E. L. Miles. Eng. & Contracting, vol. 50, no. 11, Sept. 11, 1918, pp. 254-255, 3 figs. Supply from springs; reservoirs; instructions for the construction of dams; dugout type of reservoir. (Engrg. Inst. of Canada.)

Waterwheels. Tests on a 715-Hp. High Speed Water Turbine. (Ueber Leistungversuche an einer schnell aufenden Wasserturbine von 715 Ps), W. Schmid. Schweizerische Rauzeitung, vol. 72, no. 14, Oct. 5, 1918, pp. 129-131, 4 figs.

Waterwheel Types and Settings, David R. Shearer. Power, vol. 48, no. 19, 1918, pp. 670-672, 11 figs. Various forms of waterwheels and turbines with regard to direction of flow of water, position of shaft and casing of wheel.

Waterworks. New Water Works in the City of Trier (Das neue Grundwasserwerk der Stadt Trier in Moselthal bei Kenn), Wahl. Journal für Gasbeleuchtung, year 61, nos. 7, 8, 9 and 10, Feb. 16 and 29, Mar. 2 and 10, 1918, pp. 77-81, 8 figs., pp. 85-89, 3 figs., pp. 100-104, 8 figs., and pp. 111-117, 6 figs. Extensive description with illustrations.

The Economics of Public Utilities Extensions, J. W. Ledoux. Am. City, vol. 19, no. 4, Oct. 1918, pp. 293-295. Discussion of proper relation of estimated revenue to estimated cost of water-works extension or improvement.

INDUSTRIAL ORGANIZATION

Accounting. Cost Accounting to Aid Production, C. Charter Harrison. Indus. Management, vol. 56, no. 4, Oct. 1918, pp. 273-282, 2 figs. Application of scientific management principles. (First article.)

Relation of Statistics and Accounting in Industrial Management, Milton B. Ignatius, Indus. Management, vol. 56, no. 4, Oct. 1918, pp. 312-315. Tells what matters should have statistical study and gives numerous practical points in regard to organizing work and selecting statistician.

Drafting Room. Simple Drafting Room Methods, G. F. Hamilton. Indus. Management, vol. 56, no. 4, Oct. 1918, pp. 301-304, 15 figs. How a machine building plant systemizes its drafting work.

Inspection. Inspection and Quality Control, F. E. Merriam. Indus. Management, vol. 56, no. 4, Oct. 1918, pp. 305-311, 5 figs. Practical application of underlying principles; outlines organization of an inspection department, points out divisions of work, treats of selection and training of inspectors, tells how to uphold standards, and gives suggestions on selection and application of inspection gages.

Reconstruction. Reconstruction Problems from an Engineering Standpoint. Jl. Engrs. Club of St. Louis, vol. [illegible], no. [illegible], Sept.-Oct. 1918, pp. [illegible]. Suggestions to engineering organizations.

INTERNAL COMBUSTION ENGINEERING

Constant Pressure Engines. Fuel Admission Valve of Constant Pressure Internal Combustion Engines (Das Brennstoffventil der Gleichdruckmaschine). Dinglers polytechnisches Journal, vol. 333, no. 11, May 18, 1918, pp. 85-86, 3 figs. [illegible]

Diesel Engines. Operation of Diesel Engines in China, Harold B. Wilson. Motorship, vol. 3, no. 11, Nov. 1918, pp. 9-10, 4 figs. Data concerning operation of five different Diesel makes under author's charge. (To be continued.)

The Diesel Engine; its Fuels and its Uses, Herbert Haas. Department of the Interior, Bureau of mines, bul. 156, petroleum technology no. 44, 130 pp., 73 figs. Details of three general types, explosion, Diesel and Sabathé; methods permitting use of coal-tar and coal-tar oils; classification, composition and properties of fuels; formulæ for computing fuel cost; examples of successful use of Diesel engines; selected bibliography. Also in Gas Eng., vol. 20, no. 11, Nov. 1918, pp. 513-519, 4 figs.

The True Status of Diesel Engines, J. C. Shaw. Marine Rev., vol. 48, no. 10, Oct. 1918, pp. 449-450. Remarks on rational design of an oil engine (Aug. issue) in reference to statements about ignition disturbances.

Gas Engines. 1500-hp. Gas Blowing Engine. Engineer, vol. 126, no. 3271, Sept. 6, 1918, pp. 207, 4 figs. Principally drawings of engine.

Governors. The Design of Governors, with Special Reference to Small Diesel Engines, Arthur B. Lakey. Proc. Engrs. Soc. of Western Pa., vol. 34, no. 6, July 1918, pp. 461-481, 12 figs. and (discussion) pp. 482-488, 1 fig. Points out shortcuts in design and adjustment of certain types of centrifugal governors and shows need of certain auxiliary apparatus to secure improved smoothness of running in the case of Diesel engines of small power, or with only small flywheels.

Governing. Investigation of Gas Engine Governing (Untersuchung einer Gasmaschinenreglung), A. Gramberg. Dinglers Polytechnisches Journal, vol. 333, no. 7, Apr. 6, 1918, pp. 53-55, 5 figs. Data of an extensive experimental investigation.

High-Speed Engines. High-Speed Internal Combustion Engines, Harry R. Ricardo. Mech. World, vol. 64, nos. 1645, 1649 and 1650, July 12, Aug. 9, and Aug. 16, 1918, p. 17, 7 figs. p. 69, 1 fig., and pp. 81-82, 6 figs. July 12: Comparative wear and tear of slow and high-speed engines. Aug. 9: Factors affecting volumetric efficiency and possibilities of increasing it, theories explaining detonation or "pinking." (Northeast Coast Instn. of Engrs. & Shipbuilders.)

Indicator Diagrams. The Theoretical Indicator Diagram, O. A. Malychevitch. Automotive Ind., vol. 39, no. 12, Sept. 19, 1918, pp. 499-502, 2 figs. Method of predetermining gas temperatures and pressures for various points in engine cycles from chemical composition of charge and physical properties of components.

Faults in the Design of Some Surface-Ignition Oil Engines, W. J. Woodcock. Motorship, vol. 3, no. 11, Nov. 1918, p. 16, 1 fig. An operator's idea of an improved motor.

New Type of Marine Oil Engine. Int. Mr. Eng., vol. 23, no. 10, Oct. 1918, pp. 563-566, 6 figs. Two-cycle Weiss engine; simple injection system. Description of engine and discussion of scavenging.

Oil-Engine Sprayers or Pulverizers, A. H. Goldingham and C. T. O'Brien. Motorship, vol. 3, no. 11, Nov. 1918, pp. 14-15, 5 figs. Details of various types of injection-valves. (Concluded from Sept. issue.)

The Heavy Oil Engine, Charles E. Lucke. Int. Mar. Eng., vol. 23, no. 10, Oct. 1918, pp. 579-583. Discussion of factors to be considered in design; small demand as yet for heavy oil types; future possibilities. Paper before Engrs. Club of Philadelphia, Jan. 1918.

Oil Engines. The Heavy Oil Engine, Chas. E. Lucke. Popular Engr., vol. 10. no. 4, Oct. 1918, pp. 17-18 and 22. Presentation of fideas involved in development up to present time and consideration of possibility of change in near future. Before Engrs. Club of Phila.

Power Outfit. The Increase of Power Output, Emil Schimanek. Aerial Age, vol. 8, no. 4, Oct. 7, 1918, pp. 170-173 and 193, 20 figs. Increase of power output in internal combustion by (1) increasing thermal efficiency, (2) increasing number of working strokes in unit-time, or (3) increasing air charge in working cylinders. Translated from *[illegible]*.

PULVERIZERS

(See Oil Engines.)

Sleeve Valve Engine. Tests of a Sleeve Valve Engine. Automotive Ind., vol. 39, no. 12, Sept. 19, 1918, pp. 494-498, 12 figs. Monograph diagram, horse-power and torque curves.

SPRAYERS

(See Oil Engines.)

Aliens. *(See Americanization).*

Americanization. Making Americans on the Railroad, Samuel Rea. Am. Mach., vol. 49, no. 15, Oct. 10, 1918, pp. 673-676. Methods adopted and results achieved in persuading and fitting foreign-born employees of Penn. R. R. to become loyal and useful citizens.

Apprenticeship. Cooperative Management—The Apprentice, Arthur F. Johnson. Int. Mar. Eng., vol. 23, no. 10, Oct. 1918, pp. 567-568. Apprentice a vital essential in industry; should be given liberal education; freedom of shop important for his rounded education.

BONUS SYSTEM. Fuel Bonuses in Central Stations. Prime à l'économie de charbon dans les stations centrales thermiques, L. Cotage. Revue Générale de l'Electricité, vol. 4, no. 10, Aug. 31, 1918, pp. 319-320, 1 fig. How a bonus system may be established and employees made to co-operate in the economization of fuel.

CO-OPERATION. The Babson Conference on Co-operation. Am. Mach., vol. 49, no. 17, Oct. 24, 1918, pp. 749-752. Account of conference, fifth annual, held at Wellesley Hills, Mass., Sept. 1918, on profit-sharing, labor turnover and efficiency. United States Employment Service, and experience in collective bargaining and in dealing with labor unions.

EMPLOYEE REPRESENTATION. Bethlehem Plan of Employee Representation. Iron Age, vol. 102, no. 17, Oct. 24, 1918, pp. 1020-1022, 2 figs. Monthly committee meetings and annual conferences to consider wages, working conditions, housing and all other questions of mutual interest.

HOUSING. Lodging House for Thirty Men Costs $11,000. Elec. Ry. Jl., vol. 52, no. 14, Oct. 5, 1918, pp. 615-616, 5 figs. Details of a lodging house built by Connecticut Co. at Waterbury, Conn.

SOLDIERS DISCHARGED. The Employment of Discharged Soldiers. Times Eng. Supp., no. 528, Oct. 1918, pp. 201-202. Methods by which engineering trades may help to solve problem.

SUPERVISION. The Mechanical Department Supervision Problem, Frank McManamy. Ry. Age, vol. 65, no. 17, Oct. 25, 1918, pp. 729-731. Dilution of quality of labor has increased need of more and better supervision. Abstract of paper before New York Railroad Club.

TRAINING. How Best to Educate the Road Foreman, the Engineer and the Firemen, Frank J. Barry. Proc. Central Ry. Club, vol. 26, no. 4, Sept. 1918, pp. 442-448 and (discussion) pp. 448-466. Consideration of different methods and observations on matters having bearing on character of results education is likely to produce.

Training Minor Excutives in a Large Shoe Factory, Roy Willmarth Kelly. Indus. Management, vol. 56, no. 4, Oct. 1918, pp. 316-319, 2 figs.

Training School for Machine Operators. Iron Age, vol. 102, no. 17, Oct. 24, 1918, pp. 1011-1012, 2 figs. Special department at Timken plant gives better results than breaking in no regulat department.

TURNOVER. Keeping Track of Labor Turnover, E. H. Fish. Automotive Ind., vol. 39, no. 11, Sept. 12, 1918, pp. 445-446. Suggests careful compilation and analysis of turnover records in plants where semil skilled men must be trained to meet labor needs.

WOMEN. Introducing Woman Labor into the Shop, M. C. Hobart. Am. Mach., vol. 49, no. 17, Oct. 24, 1918, pp. 769-770. Experience of a Chicago firm in this new departure.

Manufacture by Women. Times Eng. Supp., no. 528, Oct. 1918, p. 217. Account of exhibitions of women's work formed by Ministry of Munitions through Technical Section of its Labor Supply, at Liverpool.

Putting Women Into the Machine Shop, F. L. Prentiss. Iron Age, vol. 102, no. 15, Oct. 10, 1918, pp. 892-896, 2 figs. Short probationary period successful in Cleveland plants; qualities in which women excel; reduced labor turnover.

Solving New Haven's Man-Power Problem, Charlton L. Edholm. Am. Mach., vol. 49, no. 16, Oct. 17, 1918, pp. 712-723, 2 figs. Account of effort to secure service of women of New Haven in munitiions shops of Winchester Repeating Arms Co.

The Demand for and Supply of Women Workers. Automotive Ind., vol. 39, no. 12, Sept. 19, 1918, pp. 490-491. Contrast between percentages of American and English women now employed.

The Renumeration of Male and Female Labor. Eng. Rev., vol. 32, no. 3, Sept. 16, 1918, pp. 68-69. Discussion of relative efficiencies of male and female labor in the light of extensive experience in engineering shops.

Women in Central Station Work, J. W. Alexander. Jl. of Elec., vol. 41, no. 9, Nov. 1, 1918, pp. 392-393, 5 figs. Account of work being done by women as power plant operators and meter readers.

LEGAL

BUILDING LAW. Puzzling Variations in Important Building-Law Clauses, R. Fleming. Eng. News-Rec., vol. 81, no. 13, Sept. 26, 1918, pp. 579-581. Requirements as to stresses; specified wall thickness often wasteful; wind bracing neglected; interesting special features.

LIGHTING

DISPERSION OF LIGHT. Dispersion of Light as a Means of Reducing the Surface Brightness of Artificial Illuminants (Die Streuung des Lichtes als Mittel zur Verringerung der Flachenhelle küunstlicher Lichtguellen), N. A. Halbertsma. Dingler's polytechnisches Journal, vol. 333, no. 9, May 4, 1918, pp. 76-77, 2 figs.

Better Lighting of Glass Works and Potteries, F. H. Bernhard. Elde. Rev., vol. 73, no. 15, Oct. 12, 1918, pp. 567-572, 6 figs. Eighth of a series of articles on improvement in lighting in the industries.

Lighting of Rubber-Goods Factories, F. H. Bernhard. Elec. Rev., vol. 73, no. 17, Oct. 26, 1918, pp. 653-657, 5 figs. Ninth of a series on lighting in industries.

FACTORY LIGHTING. Terminal Shop and Classification Yard Lighting. Ry. Rev., vol. 63, no. 18, Nov. 2, 1918, pp. 625-627, 5 figs. General discussion of modern shop and yard lighting systems through the use of the flood system. Committee report before Convention of Assn. of Ry. Elec. Engrs., by J. E. Gardner.

HOUSE LIGHTING. The Lighting Ration in Practice. Illuminating Engr., vol. 11, no. 7, July 1918, pp. 177-181. Suggests how lighting rations under household fuel and lighting order may be expected to apply to two typical houses, having respectively six and twelve rooms.

ILLUMINANTS. Experimental Comparison of the Lighting Efficiency of Various Artificial Sources of Illumination (Zur Beurteilung fer Beleuchtungswirkung künstlicher Lichtquellen), W. Bertelsmann. Journal für Gasbeleuchtung, year 61, no. 6, Feb. 9, 1918, pp. 61-64.

LIGHTING ECONOMIES. Possible Wartime Lighting Economies. Elec. News, vol. 27, no. 21, Nov. 1, 1918, pp. 23-26, Report of committee on war service of the Illuminating Eng. Soc.

MANTLE LIGHTS. A Physical Study of the Welsbach Mantle, H. E. Ives, E. F. Kingsbury, and E. Karrer. Jl. Franklin Inst., vol. 186, no. 4, Oct. 1918, pp. 401-438, 15 figs. Details of theory of ordinary mantle, and application of Rubens methods, as well as other new methods, to mantles composed of other oxides and oxide mixtures. (To be continued.)

Urges Use of Pilots with Mantle Lamps as Fuel Conservation Measure. Am. Gas Eng. Jl., vol. 109, no. 16, Oct. 19, 1918, pp. 367-371. Report of Illuminating Eng. Soc. giving rules limiting use of artificial light to minimum necessary number of hours per day and promoting most efficient use of artificial light during those hours.

PHOTOMETERS. Improvements in the Spherical Photometer, R. von Voss. Elecn., vol. 81, no. 2104, Sept. 13, 1918, pp. 418-419, 1 fig. Abstract of an article in the "Elektrotechnische Zeitschrift," no. 52, 1917.

STREET LIGHTING. War-Time Street Lighting Economy. J. R. Cravath. Am. City, vol. 19, no. 4, Oct. 1918, pp. 303-304, 2 figs. Indicates where reductions can be made. From compilations of data and opinions of illuminating engineers throughout the country presented before Illum. Engrs. Soc.

LUBRICATION

CUTTING LUBRICANTS. Cutting Lubricants. Times Eng. Supp., no. 528, Oct. 1918, p. 218. Memorandum issued by Department of Scientific and Industrial Research, prepared by a committee of department in connection with survey of field for research on lubricants and lubrication.

EXPLOSION ENGINES. Lubrication of Explosion Engines. Petroleum World, vol. 15, no. 216, Sept. 1918, pp. 380-381. Action of oil and suggestions on selection of lubricant. (Concluded.)

MARINE ENGINES. The Lubrication of Marine Engines, Shipbuilding & Shipping Rec., vol. 12, no. 12, Sept. 19, 1918, pp. 277-278. Principles to be followed regarding place of application of oil; considerations on frequency and pressure.

VISCOSITY OF OILS. Viscosily and Constitution of Lubricating Oils. Sci. Am. Supp., vol. 86, no. 2232, Oct. 12, 1918, p. 240. Review of conclusions obtained by various experimenters.

MACHINE DESIGN

CAMS. Cam Profiles (II), Wm. Ker Wilson, Mech. World, vol. 64, no. 1649, Aug. 9, 1918, pp. 66-67, 7 figs. Displacement curves of cam giving simple harmonic motion to roller and of cam giving uniform acceleration to roller.

MACHINE PARTS

BEARINGS. Life of Ball Bearings (Ueber Lebersdauer von Kugellagern), Henry Gartner. Dingler's Polytechnisches Journal, vol. 333, no. 5, Mar. 9, 1918, pp. 35-38, 4 figs. Safe loads on ball bearings and the life of ball bearings under various conditions of loading and maintenance.

Roller Bearings for Machine Shop Equipment, Edward K. Hammond. Machy., vol. 25, no. 2, Oct. 1918, pp. 115-122, 14 figs. (Fourth article.)

The "Dragon" Ball Bearing. Can. Machy., vol. 20, no. 17, Oct. 24, 1918, pp. 475-476, 4 figs. Double row ball bearings, manufactured in standard single row widths ,in each instance containing approximately double the number of balls of corresponding single row bearing, the two rows of balls being staggered in relation to each other.

BOLTS. On the Strength of Bolts in Aeroplane Structures, John Case. Aeronautics, vol. 15, no. 253, Aug. 21, 1918, pp. 158-162, 8 figs. Analytical computation of distribution of load between several bolts bearing same load in (1) strap joint nuder direct load, (2) single lateral force divided between several bolts, (3) when there is bending. (Concluded.)

Stress Distribution in Bolts and Nuts, C. E. Stromeyer. Int. Mar. Eng., vol. 23, no. 10, Oct. 1918, pp. 589-591, 4 figs. Character and analysis of strains in butt straps; instrument for ascertaining difference in thread pitch. Paper before Inst. of Naval Architects, London, March 1918.

FLYWHEELS. Disastrous Flywheel Explosion at Chicago. Power, vol. 28, no. 15, Oct. 8, 1918, pp. 516-519, 6 figs. Details of an accident to a 24 by 42-in. 500 hp Corliss engine.

KEYWAYS. Figuring Keyways on Shafts, John Havekost. Mach., vol. 25, no. 2, Oct. 1918, pp. 152, 1 fig. A collection of formulæ.

SPROCKETS. Sprocket Design, Theory and Practice. Wiley M. Free. Mach., vol. 25, no. 2, Oct. 1918, pp. 147-150, 4 figs. Factors controlling desiginng of sprockets for mallcable chain drives, and action of chain on driving and driven sprockets under different conditions.

MACHINE SHOP

BALANCING. Methods of Balancing Rotors, C. C. Brinton. Elec. Jl., vol. 15, no. 9, Sept. 1918, pp. 349-352, 9 figs. Static and dynamic balances; balancing machines.

CHAIN MAKING. The Manufacture of a Diamond Transmission Chain, J. V. Hunter. Am. Mach., vol. 49, no. 15, Oct. 10, 1918, pp. 643-647, 13 figs. Description of some automatic and semi-automatic machines used in manufacture of transmission chain.

DRAWINGS. A Study of Drafting Room Errors, R. Fleming. Eng. & Contracting, vol. 50, no. 17, Oct. 23, 1918, pp. 378. Most common and most expensive errors made in structural drafting.

Representation of Screw Threads and Dimensioning. Can. Machy., vol. 20, no. 9, Sept. 5, 1918, pp. 291-294, 27 figs. Rules for dimensioning drawings.

Gages. Developing a Gaging System for Small Arms and Heavy Ordnance, Erik Oberg. Machy., vol. 25, no 2, Oct. 1918, pp 93-107, 9 figs. First of a series describing principles involved and procedure followed in developing gaging systems for interchangeable manufacture. Based upon experience of Pratt & Whitney Co. in furnishing gaging equipment for small arms and heavy ordnance work.

Rules for Computing Gage Tolerances, D. Douglas Demarest. Indus. Management, vol. 56, no. 4, Oct. 1918, pp 332-334, 3 figs. Three simple rules show how to compute overall length, mean length and mean depth of finish.

Gage Making. Gage Making in a Shell Plant, Franklin D. Jones. Machy., vol. 25, no. 1, Sept. 1918, pp. 1-6, 19 figs. Sixth of series of articles describing methods employed in a plant making United States 75-mm. shell.

Gear Cutting. Electric-Railway Motor Pinion Making. Am. Mach., vol. 49, no. 15, Oct. 10, 1918, pp. 648-650, 7 figs. Describing various steps in manufacture of gears and pinions for electric-railway motors.

Heat Treatment. Annealing Cold-Rolled Aluminum Sheet by Abbreviated Exposures at Various Temperatures, Robert J. Anderson. Page's Eng. Weekly, vol. 33, no. 734, Oct. 4, 1918, pp. 160-161. Report of experiments. Before Inst. of Metals.

Hosiery Machine Making. Making Hosiery-Machine Parts, Robert Mawson. Am. Mach., vol. 49, no. 16, Oct. 17, 1918, pp. 709-710, 5 figs. Sequence of operations in milling certain members of hosiery machines as practised by Hemphill Mfg. Co., Pawtucket, R. I.

Irregular Shaped Work. Generating Cams and Irregular-Shaped Work, Douglas P. Hamilton. Am. Mach., vol. 49, no. 17, Oct. 24. 1918, pp. 737-740, 12 figs. Outlining possibilities of producing in gear shaper and on a commercial basis cams and other irregular forms.

Moving Picture Machine Making. Making a Moving Picture Machine, M. E. Hoag. Am. Mach., vol. 49, nos. 16 and 17, Oct. 17 and 24, 1918, pp. 718-720, 16 figs., 759-761, 10 figs. The light shutter. (Second and third article.)

Screw Work. Production Problems of Aircraft Bolts, Screws and Nuts, W. H. Sheahan. Aviation, vol. 5, no. 6, Oct. 1918, pp. 363-365, 4 figs. Gaging machines.

TRACTOR MANUFACTURE

Manufacturing the Caterpillar Tractor, Frank A. Stanley. Am. Mach., vol. 49, nos. 17 and 18, Oct. 24 and 31, 1918, pp. 745-747, 5 figs., and 801-804, 9 figs. General features, (First and second article.)

Truck Making. Assembling the Liberty Truck, M. E. Hoag. Am. Mach., vol. 49, no. 18, Oct. 31, 1918, pp. 813-815, 11 figs. Description of methods used in a Western factory.

Welding. Cutting Test Pieces from Shells. Can. Foundryman, vol. 9, no. 8, Aug. 1918, p. 183, 1 fig. General details of machine operating by oxy-acetylene torch.

Fusion Welding Fallacies, S. W. Miller. Machy., vol. 25, no. 2, Oct. 1918, pp. 123-124, 2 figs. (Fourth article.)

New Work for the Welding Engineer, C. W. Brett. Aeronautics, vol. 15, no. 253, Aug. 21, 1918, pp. 170-171, 4 figs. Shows application of welding to an aluminum airplane engine crankcase and to a cast-iron cog wheel.

Practical Data Upon Electrical Spot Welding, G. A. Hughes and R. H. Pool. Elec. World, vol. 72, no. 16, Oct. 19, 1918, pp. 742-744, 2 figs. Power consumption, strength of welds and speed with which welds can be made determined for various kinds of plates.

Selection and Application of Electric Arc Welding Apparatus, A. M. Caudy. Elec. Jl., vol. 15, no. 9, Sept. 1918, pp. 337-346, 25 figs. Requisites for alternating-current arc welding and direct-current arc welding; constant current versus constant potential generators; protective equipment and accessories; welding principles; selection of electrodes; gas versus electric arc.

Some Notes on the Resistance Method of Electric Welding, G. W. Stubbings. Mech. World, vol. 64, no. 1654, Sept. 13, 1918, p. 124, Manner of applying electric supply to weld in case of direct current and also in case of alternating current.

The Oxy-Acetylene Process for Welding Boiler-Plate, H. A. Boyd. Mech. World, vol. 64, no. 1649, Aug. 9, 1918, pp. 69-70. Result of tests made of three pieces taken from new boiler-plate. (Cal. Safety News.)

The Practice of Oxy-Acetylene Welding, J. T. Morton. Aeronautics, vol. 15, no. 253, Aug. 21, 1918, pp. 165-169, 12 figs. Suggestions regarding selection of burners, determination of correct proportions of burning gases in flame and other details of process.

MACHINE TOOLS

Second Hand Tools. The Buying of Second-Hand Machine Tools, Donald A. Hampson. Can. Machy., vol. 22, no. 16, Oct. 17, 1918, pp. 466-467. Importance of determining age of machine and its serial number.

Sine-Bar Fixture. Sine-Bar Fixture. Machy., vol. 25, no. 2, Oct. 1918, pp. 154-146, 4 figs. Drawings of fixture and explanation.

MARINE ENGINEERING

Boat Lowering. Boat Lowering Appliances, J. R. Hodge. Tran. Inst. Marine Engrs., vol. 30, paper 237, Aug. 1918, pp. 123-127, 4 figs. and (discussion), pp. 127-136. Discusses merits of gear for lowering and disengaging of boats from vessels in emergencies at sea.

Boilers. Sediment in Marine Boilers, W. R. Austin. Steamship, vol. 30, no. 352, Oct. 1918, pp. 94-95, 1 fig. Points out where risk of accident generally arises.

Cargo Gear. Some Insufficiently Considered Details of Ship Construction and Equipment, C. Waldie Cairns. Int. Mar. Eng., vol. 23, no. 10, Oct. 1918, pp. 570-575. Analysis of conditions of yard management; details of ship equipment criticized; stresses on cargo gear. Paper before northeast Coast Inst. of Engrs. & Shipbuilders, Newcastle-upon-Tyne.

Concrete Ship. Concrete Barges Built True to Design Dimensions. Eng. News-Rec., vol. 81, no. 16, Oct. 17, 1918, pp. 701-707, 6 figs. Special spacer fix wall thickness and rod location; account of yard started at Providence, R.I.

Method of Building Concrete Barges at Yard of Aberthaw Construction Co. Eng. & Contracting, vol. 50, no. 17, Oct. 23, 1918, pp. 383-384, 3 figs. Description of work in progress at Fields Point, R. I. Also in Int. Mar. Eng., vol. 23, no. 10, Oct. 1918, pp. 584-585, 3 figs.

Novel Method of Constructing Concrete Vessels, R. N. Stroyer. Shipbuilding & Shipping Rec., vol. 12, no. 14, Oct. 3, 1918, pp. 327-330, 5 figs. Description of writer's patented system which aims to reduce number of joints to minimum.

Standard Concrete Barge for Use on the New York State Barge Canal. Int. Mar. Eng., vol. 23, no. 10, Oct. 1918, pp. 586-588, 6 figs. Authorized design for service on state canal; unusual refinement of concrete used; plans and specifications.

The Building of Reinforced Concrete Ships. Engineering, vol. 106, no. 2744, Aug. 2, 1918, pp. 114-115, 4 figs. Illustrations taken at various stages of work showing reinforcing, etc.

Diving Machinery. Sisson Diving Machine. Steamship, vol. 30, no. 352, Oct 1918, pp. 79-80, 2 figs. Oval shaped machine 9 ft. long, 7 ft. 6 in. in diameter, 9 tons weight, with pair of propellers on bottom for moving up and down and two on side for propelling forward or back.

Motorships. Motor Ship "Santa Margarita." Steamship, vol. 30, no. 352, Oct. 1918, pp. 91-92. Detail of ship equipped with Diesel Engines.

Propellers. Screw Propellers. Shipbuilding & Shipping Rec., vol. 12, no. 14, Oct. 3, 1916, pp. 331-332, 1 fig. Shape of blades and patent propellers; propeller immersion and efficiency. (Concluded.)

Rivetless Ships

See Welded Ships

Salvage. Thirteen-Thousand-Ton Vessel Righted by Rolling and Lifting. Eng. News-Rec., vol. 81, no. 17, Oct. 24, 1918, pp. 764-767, 8 figs. Raising of "St. Paul" after settling on its side between New York piers.

Signaling. A Method of Avoiding Collision at Sea, J. Joly. Proc. Roy. Soc., vol. 94, no. A664, Aug. 1, 1918, pp. 547-560, 4 figs. Based on synchronized signals transmitted in different media, no other communication being necessary between the ships beyond signals.

Smoke System, Yarrow. The Yarrow Anti-Submarine Smoke System. Engineer, vol. 126, no. 3272, Sept. 13, 1918, pp. 218-219, 5 figs. Description of a smoke screen system of protection.

Standardized Ships. German Views on Standard Vessels, W. Kreul. Shipbuilding & Shipping Rec., vol. 12, no. 9, Aug. 29, 1918, pp. 212-213. Standardization as a means for accelerating building of ships; constructional parts and processes. Translated from Stahl und Eisen.

Standardized Concrete Ships in the United States. Shipbuilding & Shipping Rec., vol. 12, no. 9, Aug. 29, 1918, pp. 210-212. Alternative arrangement of concrete distributing plant.

Standardized Ships May be Permanent. Nautical Gaz., vol. 94, no. 17, Oct. 26, 1918, p. 224, 1 fig. Advantages and drawbacks of vessels of uniform type. From Engineering, London.

Stresses. Investigation of the Shearing Force and Bending Moment Acting on the Structure of a Ship, Including Dynamic Effects, A. M. Robb. Int. Mar. Eng., vol. 23, no. 10, Oct. 1918, pp. 592-593, 3 figs. Paper before Int. of Naval Architects, London, March 1918.

Trimming Conveyor. Portable Automatic Trimming Conveyor. Colliery Guardian, vol. 96, no. 3012, Sept. 20, 1918, pp. 601-602, 6 figs. Description of an automatic conveyor used for trimming coal in bunkers on shipboard.

Valves, Kingston. Hand-Regulated Valves. Mech. World, vol. 64, no. 1650. Aug. 16, 1918, pp. 78-79, 7 figs. Kingston valves of ships as examples of construction where element of safety is predominant above other considerations. (Concluded from Aug. 2.)

Welded Ships. The British Welded-Steel Motorship. Motorship, vol. 3, no. 11, Nov. 1918, pp. 22-23, 5 figs. Method of operation of novel type of oil engine installed in a merchant vessel.

MATHEMATICS

Bessel Functions. The Addition Theorem of the Bessel Functions of Zero and Unit Orders, John R. Airey. Lond., Edinburgh & Dublin Phil. Mog., vol. 36, no. 213, Sept. 1918, pp. 234-242. Form of addition theorem of Jn (x) functions in which one of the terms is a root of a Bessel or Neumann function of zero or unit order.

Collineation Groups. A Collineation Group Isomorphic with the Group of the Double Tangents of the Plane Quartic, C .C. Bramble. Am. Jl. of Mathematics, vol. 40, no. 4, Oct. 1918, pp. 351-365. Derivation by mapping methods of collineation group in which variables are irrational invariants of quartic curve; system for group and associated canonical forms of quartic.

Differential Equations. On the Asymptotic Solution of the Non-Homogeneous Linear Differential Equation of the nth order. A Particular Solution, W. Van N. Garretson. Am. Jl. of Mathematics, vol. 40, no. 4, Oct. 1918, pp. 341-350. Considers non-homogeneous equation where roots of characteristic equation are distinct, and follow, at the outset, the method employed by Dini in his researches on linear differential equations published in Annali di Matematica, ser. 3, vol. 2 (1898), pp. 297-324 and vol. 3 (1899), pp. 125-183.

Fourier Theorem. Fourier's Theorem and the Trigonometric series (Sur le théorème de Fourier et les développements en séries trigonométriques), G.-A. Andrault. Revue Générale de l'Electricité, vol. 4, no. 10, Sept. 7, 1918, pp. 331-340, 3 figs. Method of demonstrating synthetically and generalizing Fourier's theorem and study of the physical significance and independence of the coefficients.

History of Mathematics. Plans for a History of Mathematics in the Nineteenth Century, Florian Cajori. Sci. vol. 48, no. 1238, Sept. 20, 1918, pp. 279-284, 2 figs. Determination of volume of mathematical literature to be penetrated. Before Am. Mathematical Soc.

Plane Algebraic Curves. On the Plane Algebraic Curves having Common Multiple Points (Sur les courbes algébriques planes ayant des points multiples communs), R. de Montessus de Ballore. Comptes Rendus des Séances de l'Académie des Sciences, vol. 167, no. 8, Aug. 19, 1918, pp.290-293. Analytical investigation of contact of two curves or order *n*.

Pohlke's Theorem. Proof of Pohlke's Theorem and its Generalization by Affinity, Arnold Emch. Am. Jl. of Mathematics, vol. 40, no. 4, Oct. 1918, pp. 366-374, 3 figs. Proof of generalization and establishment of related propositions, by making use of affine collineations in space of theorem: Three straight line segments of arbitrary length in a plane, drawn from a point and making arbitrary angles with each other, form a parallel projection of three equal segments drawn from the origin on three rectangular coördinate axes; however, only one of the segments, or one of the angles, can vanish.

Theta Modular Groups. Theta Modular Groups Determined by Point Sets, Arthur B. Cable. Am. Jl. of Mathematics, vol. 40, no. 4, Oct. 1918, pp. 317-340. Establishes theorems concerning connection between point set and theta modular function in discontinuous groups defined by g.

MECHANICS

Arches. Direct Design of Curvature of Arches, Frank Barber. Can. Engr., vol. 35, no. 18, Oct. 31, 1918, pp. 379-381, 3 figs. Analytical method of finding ordinates of curve for concrete and masonry arches, with example.

Columns. Columns Subjected to Compression and Bending (Stänger utsatta för tryck och böjning), A. Palmgvist. Tecknisk Tidskrift, Vag och vatten Byggnadskonst vol. 48, no. 9, 1918, pp. 137-142, 5 figs.

Motion, Dissipation of. The Law of Dissipation of Motion, Ernst Jonson. Am. Jl. of Sci., vol. 46, no. 274, Oct. 1918, pp. 578-580, 2 figs. Derivation of law by resolving motion resulting from collision of two particles into two perpendicular components in such a way that each component of one motion is parallel to one of components of other motion, and that the two components which have same direction have also same size.

Relativity, Principle of. The Principle of Relativity in Mechanics (Het relativiteitsbeginsel in de mechanica), G. J. Van de Well. De Ingenieur, year 33, no. 38, Sept. 21, 1918, pp. 736-747, 1 fig.

Shafts, Critical Velocity. A New Critical Velocity Occurring when the Bending of a Shaft is Accompanied by Vibrations (Eine neue kritische Wellengeschwindigkeit bei mit Biegung verbundenen Schwingungen), Gimbel. Dingler's polytechnisches Journal, vol. 333, no. 9, May 4, 1918, pp. 71-75, 2 figs.

A New Critical Velocity of Rotating Shafts (Eine neue kritische Wellengeschwingigkeit), A. Stodola. Dingler's polytechnisches Journal, vol. 333, nos. 1 and 3, Jan. 12 and Feb. 9, â918, pp. 1-3, 1 fig., and pp. 17-19. (From Schweiz, Bauxeitung, Nov. 1917). An important article on the critical velocity of shafts containing interesting new views.

Critical Speeds of Shafts, G. Bonner. Mech. World, vol. 64, no. 1654, Sept. 13, 1918, pp. 128-129, 1 fig. Diagrammatic representation of torsion, thrust and centrifugal action stresses. Before N. E. Section Junior Instn. of Engrs. (To be continued.)

Torsional Stresses. Torsional Stresses, F. W. Salmon. Machy., vol. 25, no. 2, Oct. 1918, p. 108. Table for finding torsional stresses for various sizes of shafts and of various sections.

METAL ORES

Chromium. Chromite, J. C. Williams. Min. & Eng. Rec., vol. 23, nos. 15 and 16, Aug. 31, 1918, pp. 160-162. Foreign deposits, ore in United States; uses; alloys; description; occurrence; concentration; and recognition of this mineral.

Iron. The Occurrence of Iron Ores in East Netherlands (Het voorkomen van ijzeretsen in OOst-Nederland), W. H. D. de Iongh. De Ingenieur, year 33, no. 34, Aug. 24, 1918, pp. 644-648, 2 figs.

Talc. Talc: Its Occurrences and Uses, Percy A. Wagner. Min. Mag., vol. 19, no. 4, Oct. 1918, pp. 218-220. Occurrences in South Africa and information as to uses throughout the world. From South African Jl. of Ind.

Tungsten. The Genesis of Tungsten Ores, R. H. Rastall. Min. Jl., vol. 123, no. 4338, Oct. 12, 1918, pp. 597-598. Sheelite deposits; secondary tungsten deposits. From Geological Mag. (Continuation of serial.)

METAL WORKING TOOLS

Boring Machine. Cylinder Boring Machine. Can. Machy., vol. 20, No. 17, Oct. 24, 1918, p. 485, 1 fig. Although specially designed for boring cylinders of Liverty motors, the machine can, by slight changes in design of gearing, etc., be made to accommodate most boring operations.

Gidding and Lewis No. 4, Boring, Milling and Drilling Machine. Am. Mach., vol. 49, no. 17, Oct. 24, 1918, pp. 777-778, 1 fig. Principal dimensions and general description.

Centering Machine. Machine for Accurately Centering Shells. Can. Machy., vol. 22, no. 16, Oct. 17, 1918, p. 455, 1 fig. System followed by Modern Tool Mfg. Co.

Chisels. The Cold Chisel, J. A. Lucas. Coal Age, vol. 14, no. 16, Oct. 17, 1918, pp. 730-734, 27 figs. Various types of cold chisels and their uses.

Lathe. Massive Shell Lathes for Nevill Island. Iron Age, vol. 102, no. 18, Oct. 31, 1918, pp. 1071-1074, 5 figs. Machine for boring and turning shells 12 in. in diameter and larger and features developed especially for operations in view.

Simplified Lathe Adapted to Shell Work. Iron Age, vol. 102, no. 16, Oct. 17, 1918, pp. 945-948, 13 figs. Description of 16- and 25-in. simplified Gisholt lathes.

Locomotive Repair Tools. Repairing Locomotive Fittings, Frank A. Stanley. Am. Mach., vol. 49, no. 15, Oct. 10, 1918, pp. 663-665, 8 figs. Description of tools used in Californian railway repair shop.

METALLURGY

Brass. Thermal Expansion of Alpha and of Beta Brass between 0-600 Deg. Cent., P. D. Merica and L. W. Schad. Jl. Franklin Inst., vol. 186, no. 4, Oct. 1918, p. 511. Comparison of thermal expansions of two constituents, alpha and beta, of which 60:40 brass is composed. (Abstract.)

Bronze, Phosphorus Content. Estimating Phosphorus in Bronzes, R. E. Rooney. Practical Engr., vol. 58, no. 1648, Sept. 26, 1918, p. 153. Table showing results obtained with different samples of commercial bronze by rapid and gravimetric methods of analysis.

Copper. Pure Carbon-Free Manganese and Manganese Copper, Arthur F. Braid. Bul. Am. Inst. Min. Engrs., no. 143, Nov. 1918, pp. 1697-1698. Deoxidizers and their uses in copper alloys.

Flue Gases. Precipitation from Flue Gases. Elec. Rev., vol. 73, no. 15, Oct. 12, 1918, p. 575, 2 figs. Description of installation at copper refinery where copper particles ar recovered by the Cottrell process.

Grain Growth. Grain Growth in Metals, Zay Jeffries. Practical Engr., vol. 58, no. 1648, Sept. 26, 1918, pp. 151-153. Definition of germinative temperature; general laws of grain growth; typical examples. (Continuation of serial.)

Hardness of Metals. Hardness and Hardenings, T. Turner. Metal Ind., vol. 16, no. 10, Oct. 1918, pp. 460-464, 1 fig. Address before British Inst. of Metals, Sept. 1918.

MILITARY ENGINEERING

Ambulance Trains. An Ambulance Train for the American Army. Engineer, vol. 126, no. 3274, Oct. 27, 1918, pp. 260-262, 15 figs. Drawings and description of the British-built American ambulance train for American army.

Artillery. On the Propagation of Sound of a Cannon at a Great Distance (Sur la propagation du son du canon à grande distance), Maurice Collington. Comptes Rendus des Séances de l'Académie des Sciences, vol. 167, no. 9, Aug. 26, 1918, pp. 333-335. Table of results of experimental work.

Variation of the Sight Position in Firing at Different Angles of Elevation (Aenderung der Visiersgellung helm Schiessen unted verschiedenen Gelyandewinkein), K. Michalke. Dingler's polytechnisches Journal, vol. 333, no. 10, May 18, 1918, pp. 82-84, 5 figs.

Explosives. Digging Pole Holes with Dynamite, C. R. Van Druff. Telephony, vol. 75, no. 18, Nov. 2, 1918, pp. 36-38, 4 figs. Method of blasting holes with dynamite to produce satisfactory results in different kinds of soil.

Sengite: The New South African Explosive, J. P. Udal. Min. Mag., vol, 19, no. 4, Oct. 1918, pp. 215-216. Gun-cotton base explosive, made by same process as tonite but substituting nitrate of soda for nitrate of barium. From South American Jl. of Ind.

Supply Base. Army Supply Base, South Brooklyn, N. Y. Contracting, vol. 7, no. 9, Nov. 1, 1918, p. 279. Placing of more than 11,000 yd. of floor and roof concrete.

MINES AND MINING

Drills. Diamond-Drilling in Cornwall, J. A. MacVicar. Min. Mag., vol. 19, no. 4, Oct. 1918, pp. 184-197. Work done with Sullivan diamond-drill and author's opinion as to future possibilities.

Improved Sharpener Dies Make Better Drill Bits, Howard H. Walish. Alaska & Northwest Min. Jl., vol. 12, no. 10, Oct. 1918, p. 91, 3 figs. Chart showing results obtained by one of largest copper mines in United States.

Efficiency. Increasing Coal Mine Efficiency, Charles E. Stuart. Coal Age, vol. 14, no. 16, Oct. 17, 1918, pp. 724-727, 5 figs. First of a series of articles on mine efficiency.

Engineers. The Work of the Mining Engineer, R. S. McCaffrey. Wisconsin Engr., vol. 22, no. 7, April 1918, pp. 285-286. Requirements of mining geology, mine engineering, and metallurgy.

Mine Gases. The Limits of Complete Inflammability of Mixtures of Mine Gases and of Industrial Gases with Air, Geo. A. Burrell and Alfred W. Ganger. Sci. Am. Supp., vol. 86, no. 2232, Oct. 12, 1918, p. 236, 2 figs. Results of experiments. From Tech. Paper 150, Bureau of Mines, Dept. of Interior.

Oil Shales. A Possible Fuel Oil Industry for Canada. James Ashworth. Can. Min. Jl., vol. 39, no. 19, Oct. 1, 1918, pp. 330-331. Discusses possibilities of encouraging production of oil and other by-products from coal and oil shales.

Ventilation. Canvas Tubing for Mine Ventilation, Lester D. Frink. S. A. Min. Jl., vol. 27, part 2, no. 1406, Sept. 7, 1918, p. 421. Explains manner in which canvas tubing is being used in the North Butte Co.'s mine sat Butte, Mont. (To be continued).

Water in Mines. The Unwatering of the Pensford Colliery, Charles Lewis. Iron Coal Trades Rev., vol. 97, no. 2640, Oct. 4, 1918, pp. 381-374, 6 figs. Before South Wales Branch of Assn. of Min. Elec. Engrs., Sept. 1918.

MOTOR CAR ENGINEERING

Alcohol. The Utilization of Alcohol and Mixtures of Alcohol with Hydrocarbons, such as Benzole instead of Gasoline in Motor Cars, D. Tagneyeff (in Russian). Proc. of Russian Technical Soc., year 1917, nos. 4-7. Apr.-July, pp. 51-57, 1 fig. Data of works carried out by various German engineers.

Crane Tractor. An Electric Crane Tractor. Can. Machy., vol. 20, no. 14, Oct 3, 1918, pp. 399-400, 1 fig. Machine with 15-ton trailing load capacity and provided with removable battery compartment.

ENGINES. Doris Two-Ton Truck Model K-1. Automotive Ind., vol. 39, no. 12, Sept. 19, 1918, pp. 508-509, 4 figs. Detachable cylinder head design [illegible] with valve cages.

STEAM MOTORS. A New Coal Fuel Steam Motor. Engineer, vol. 126, no. 3266, Aug. 2, 1918, pp. 101-102, 11 figs. Detail of coke fuel boiler and [illegible] used in new steam automobile.

TIRES. Tires for Tractor and Similar Vehicle Wheels. India Rubber Jl., vol. 56, no. 14, Oct. 5, 1918, p. 6, 4 figs. Invention said to enable any existing tractor wheel of any diameter to be readily fitted with a number of studs or projections which will improve grip of wheel.

TRACTORS. The Wolverine Tractor. Auto, vol. 23, no. 40, Oct. 4, 1918, pp. 733-735, 7 figs. General features of 2-ton 30-15 hp. for three furrow ploughing.

TRANSMISSIONS. The Nuttall Traction Transmission. Automotive Ind., vol. 39, no. 12, Sept. 19, 1918, pp. 506-507, 4 figs. Designed to give two forward speeds and reverse and adaptable to either a longitudinally or a transversely mounted engine.

MUNICIPAL

POLES. Joint Usage of Poles—A War Economy, F. N. Bradshaw. Elec. World, vol. 72, no. 18, Nov. 2, 1918, pp. 840-841, 1 fig. Statement of civic, economic and safety advantages resulting from adoption of practice; opinions regarding the form of construction which should be employed. Paper before International Assn. of Municipal Electricians, Atlanta, Sept. 1918, by A. L. Pierce.

SANITARY SURVEY. A Sanitary Survey of a City. Mun. Jl. vol. 45, no. 19, Nov. 9, 1918, pp. 359-361, 3 figs. Account of survey made by a State board of health. (To be concluded.)

STREET CLEANING. A Report on Street Cleaning. Good Roads, vol. 16, no. 17, Oct. 26, 1918, pp. 160-161. Text of reports submitted to Am. Soc. of Mun. Improvements by its committee on street cleaning.

Motor Apparatus in Buffalo Street Department, W. F. Schwartz. Mun. Jl., vol. 45, no. 17, Oct. 26, 1918, pp. 317-318, 1 fig. Sweepers and flushers. Before Am. Soc. Mun. Improvements.

Street Cleaning in San Francisco, Chas. W. Geiger. Mun. Jl., vol. 45, no. 17, Oct. 26, 1918, pp. 315-317, 7 figs. Downtown streets swept by day and flushed by night; districting and increasing efficiency of force.

SURVEYING. Problems in City Surveying, W. W. Perrie. Can. Engr., vol. 35, no. 12, Sept. 19, 1918, pp. 257-260, 3 figs. and (discussion), pp. 260-261, 1 fig. Classification and description of resurveys. Before Assn. Ont. Land Surveyors.

MUNITIONS

AMMONIA. Why We Are Asked to Conserve Ammonia, W. F. Sutherland. Power House, vol. 11, no. 10, Oct. 1918, pp. 290-291. Importance of ammonia in modern warfare.

CHUCKS. Chuck for Three-Inch Shrapnel Shells, Donald A. Baker. Machy., vol. 25, no. 2, Oct. 1918, pp. 111, 3 figs. Describes and gives drawings of chuck.

EXPLOSIVES. Military Explosives of To-day (III), J. Young. Jl. Roy. Soc. of Arts, vol. 66, no. 3439, Oct. 18, 1918, pp. 733-742, 4 figs. Requirements and classification of high explosives for shell filling; methods of detonation; tests for explosives; rate of detonation.

FUSES. Making the Mark III Detonating Fuse, Edward K. Hammond. Machy., vol. 25, no. 2, Oct. 1918, pp. 137-144, 13 figs. (Second article.)

GUNS. The Development of Gun Manufacture, W. H. W. Skerrett. Am. Mach., vol. 49, no. 15, Oct. 10, 1918, pp. 655-661, 9 figs. Reviews construction and manufacture of guns from earliest times up to present high-pressure methods.

SHELL ASSEMBLING. DIE. Shell Base-Cover Assembling Die and Press, P. H White. Machy., vol. 25, no. 2, Oct. 1918, pp. 109, 5 figs. Describing a die and press developed by Root-Van Dervoort Engineering Co. of East Moline, Ill.

SHELLS. Cast Iron Shells in Permanent Moulds, Edgar A. Custer. Foundry Frade Jl., vol. 20, no. 201, Sept. 1918, pp. 471-473, 2 figs. Essentials in their manufacture and data on a 1100-lb. casting.

High Explosive Shells and Shrapnel, J. M. Hall. Iron & Steel Inst. of Can., vol. 7 no. 8, Sept. 1918, pp. 333-338, 4 figs. Outline of general practice as used by one of largest producers. Before Steel Treating Research Soc.

Machining and Gaging 9.2-inch High-Explosive Howitzer Shells, M. H. Potter. Machy., vol. 25, no. 2. Oct. 1918, pp. 125-132, 17 figs. Machines and tools used, successive order of machining operations, and complete gaging equipment.

Making Semi-Steel Projectiles. Iron Age, vol. 102, no. 15, Oct. 10, 1918, pp. 879-883, 22 figs. Method of molding, including come making, and machining as practiced by American Radiator Co., at Buffalo.

The British 6-in. Howitzer. I. W. Chubb, Am. Mach., vol. 49, no. 16, Oct. 17, pp. 697-704, 24 figs. Breech Mechanism. (Fourth articles.)

SMALL ARMS. Revolvers and Automatic Pistols (Les revolvers et les pistolets automatiques). L. Cabanes. Génie Civil, vol. 73, no. 6, Aug. 10, 1918, pp. 110-113, 12 figs. Mauser, 1912 model; parabellum; Manlicker, 1900. Continuation of serial.)

STOKES GUN. The Stolkes Bomb-Throwing Gun (II), Wilfred Stokes. Sci. Am. Supp., vol. 86, no. 2232, Oct. 12, 1918, pp. 228-230, 14 figs. Details of projectile and of propellant; range; time fuse; percussion fuse. (Concluded.) Also in Sci. Am. Supp., vol. 86, no. 2231, Oct. 5, 1918, pp. 212-213, 10 figs.

PAINTS AND FINISHES

OIL, INFECTED. Paint Disease, James Scott. Ry. Engr., vol. 39, no. 465, Oct. 1918, pp. 198-199, 3 figs. Experimental confirmation of author's previous statement in regard to destructive effect of infected oil.

PHYSICS

ACOUSTICS. Note on the Theory of the Double Resonator, Lord Rayleigh. Lond., Edingburgh & Dublin Phil. Mag., vol. 36, no. 213, Sept. 1918, pp. 231-234. Direct mathematical consideration of the general case of a double resonator where two reservoirs of different vo.umes communicate with each other and with the atmosphere by narrow passages. This case cannot be treated by formula given in author's Theory of Sound.

ADSORPTION OF GASES. The Adsorption of Gases on Plane Surfaces of Glass, Mica and Platinum, Irving Langmuir. Jl. Am. Chem. Soc., vol. 40, no. 9, Sept. 1918, pp. 1361-1403. Experimental confirmation of author's theory of adsorption—that it is the result of time lag between condensation of gas molecule impinging on solid and its subsequent evaporation—against results obtained by other investigators who claim that adsorbed films are relatively thick.

AGGREGATES. A Geometrical Basis for Organic and Inorganic Phenomena, John Millis. Science, vol. 48, no. 1241, Oct. 11, 1918, pp. 353-360, 1 fig. Geometrical analysis of principle stated in previous paper by writer: In any aggregation of an indefinite number of equal spherical bodies an arrangement giving minimum total volume occupied and perfect symmetry is immpossible.

AIR. Physics of the Air, W. J. Humphreys. Jl. Franklin Inst., vol. 186, no. 4, Oct. 1918, pp. 481-510, 3 figs. Types and latitude variation of aurora polaris; gradient wind velocity tables for every 5 deg. of latitude from 25 to 60 deg (Concluded.)

ARC, CIRCULAR. Some Two-Dimensional Potential Problems Connected with the Circular Arc, W. G. Bickley. Lond., Edingburgh & Dublin Phil. Mag., vol. 36, no. 213, Sept. 1918, pp. 273-279, 6 figs. Drawlings of stream lines in case of disturbance due to infinitely long lamina in the form of circular arc, examination of cases of rotation of the arc, and brief discussion of motion of arc when free to move and acted upon by the consequent fluid pressures.

ARC, ELECTRIC IN GASES. Experimental Examination of the Arc in Gases under Pressure, W. Mathiesen. Elecn., vol. 81, no. 2106, Sept. 27, 1918, pp. 451-452, 2 figs. Abstract of article in Elektrotechnische Zeitschrift, no. 49, 1917.

CRYSTALS. New Method of Analysis of Crystals by Means of X-Rays (Nouvelle méthode d'analyse des cristaux au moyen des rayons X). Revue Générale des Sciences, year 29, nos. 15-16, Aug. 15-30, 1918, pp. 449-450. Method consists of photographing diffraction image obtained by passing narrow pencil of monochromatic X-rays through an ensemble of small crystals of substance.

EVAPORATION. The Evaporation of Small Spheres, Irving Langmuir.Phys. Rev., vol. 12, no. 5, Nov. 1918, pp. 368-370. Suggests theoretical explanation for phenomena observed in experiments on evaporation of small iodine spheres of about one millimeter diameter performed by Harry W. Morse and described in Proc. Amer. Acad. Arts & Sci., vol. 45, Apr. 1910.

HEAT. Is the Principle of Equivaleace a Consequence of Carnot's Principle? (Le principe de l'équivalence est-il une conséquence du principe de Carno?t). C. Raveau. Comptes Rendus des Séances de l'Académie des Sciences, vol. 167, no. 9, Aug. 26, 1918, pp. 329-331. On the nature of heat as directly deductible from the postulate of Carnot.

OPTICS. An Optical Method for Accurately Dividing a Circle into Degrees. R. S. Clay. Sci. Am. Supp., vol. 86, no. 2229, Sept. 21, 1918, pp. 188-189, 5 figs. Based on symmetrical images by two inclined mirrors. From Trans. Opt. Soc., London.

The Scattering of Light by Air Molecules, R. W. Wood. Lond., Edinburgh & Dublin Phil. Mag., vol. 36, no. 213, Sept. 1918, pp. 272-273. Result of experiments indicating that ultra-violet light causes precipitation of something from air, causing a slight cloud.

ROTATION. Rotations in Hyperspace, C. L. E. Moore. Proc. Am. Acad. of Arts and Sci., vol. 53, no. S. July, 1918, pp. 651-694. Discussion of (1) resolution of a complex 2-vector V, in space of $2p$ dimensions into the sum of p mutually perpendicular simple 2-vectors; (2) application of preceding results to show that a rotation in a space of $2p$ dimensions leaves p mutually completely perpendicular planes invariant; and (3) the consideration of variety V_p left invariant by all transformations leaving same set of p planes invariant.

SOLUTIONS. Crystalloluminescence, Harry B. Weiser. Jl. Phy. Chem., vol. 22, no. 7, Oct. 1918, pp. 480-509, 1 fig. Determination of conditions producing maxi-7, Oct. 1918, pp. 480-509, 1 fig. Determination of conditions-mum intensity of luminescence in experiments with sodium chloride, potassium chloride, potassium bromide, potassium iodide, sodium bromide, and sodium iodide.

Planck's Formula for the Potential Difference between Solutions and the Values of Certain Important Cells, H. A. Fales and W. C. Vosburgh. Jl. Am. Chem. Soc., vol. 40, no. 9, Sept. 1918, pp. 1291-1316, 5 figs. Investigation of validity of formula by experimenting with solutions of potassium chloride and hydrochloric acid.

The Osmotic Action of Solutions of Cane Sugar, Silver Nitrate, and Lithium Chloride in Pyridine, When Separated from Pyridine by a Rubber Membrane, Alfred E. Koenig. Jl. Phys. Chem., vol. 22, no. 7, Oct. 1918, pp. 461-479, 4 figs. Description of improved cell for measurement of osmotic pressures with flexible sheet membranes, such as dental rubber; account of variations in osmotic pressures by alteration in nature of rubber owing to its contact with pyridine.

STATE, EQUATION OF. On the Influence of the Finite Volume of Molecules on the Equation of State, Megh Nad Shaba and Satyendra Nath Basu. Lond., Edinburgh & Dublin Phil. Mag., vol. 36, no. 212, Aug. 1918, pp. 199-202, Argument to show that b in van der Waal's equation of state, taking into account finiteness of molecules and influences of forces of cohesion, does not properly represent influence of finite molecular volumes.

VIBRATIONS. Forced Vibrations Experimentally Illustrated, E. H. Barton and H. M. Browning. Lond., Edinburgh & Dublin Phil. Mag., vol. 36, no. 212, Aug. 1918, pp. 169-178, 2 figs. Types af experiments by serrating qualitatively and quantitatively the chief phenomena concerned with forced vibrations similar to the ones occurring in resonance tubes, fluorescence. Lodge's symtonic jars, Hertz's oscillator and resonator, and wireless telegraphy, detailed theory explaining them.

On Kirchhoff's Formulation of the Principle of Huygens, A. Anderson. Lond., Edinburgh & Dublin Phil. Mag., vol. 36, no. 213, Sept. 1918, pp. 261-270, 6 figs. Deviation from usual procedure to establish Kirchhoff's formula consisting in beginning with a single source and assuming that the vibrational velocity at a distance r from a source of disturbance is M/r [illegible], where M is a constant and a the velocity of propagation.

PIPE

Joints. Cement Joints for Gas Mains. Eng. & Cement World, vol. 13, no. 4, Aug. 15, 1918, pp. 21-23, 3 figs. Suggestions regarding design of cement joints made from experimental tests conducted at Iowa State College, Ames, and Highland Park College, Des Moines. Abstract of article in Iowa Engr., Apr. 1918.

Sewer Pipe. How Glazed Cement Sewer Pipe is Made. Cement & Eng. News, vol. 30, no. 8, Aug. 1918, p. 22. Description of Process followed by a Cal. manufacturing concern.

Winter Breakages. Methods for Obviating Pipe Breakages in Winter (Beseitigung der Gefahr von Rohrbruchen bei Froстwetter), Lorenz. Journal fur Gasbeleuchtung, year 61, no. 20, May 18, 1918, pp. 236-237.

POWER GENERATION AND SELECTION

Agriculture. Note on the Applications of Electricity to Agriculture (sur les applications de l'électricité à l'agriculture). Revue Générale de l'Electricité, vol. 4, no. 10, Sept. 7, 1918, pp. 352-354. Conditions under which a central station for rural power consumption can be installed.

Costs. Mastering Power Production, Walter N. Polakov. Indus. Management, vol. 56, no. 4, Oct. 1918, pp. 21-329, 6 figs. Principle of essential cost and use of standard cost. (Ninth article.)

Docks. Utilization of Electricity in Docks and Harbors. Shipbuilding & Shipping Rec., vol. 12, no. 9, Aug. 29, 1918, pp. 205-206. Review of possibilities opened up by recommendations of Coal Conservation Committee recently issued by Ministry of Reconstruction.

Dredging. Using Electric Power to Dredge a Relocated River Channel, J. H. Walter. Eng. News-Rec., vol. 81, no. 16, Oct. 17, 1918, pp. 723-725. Washington Counties build suction dredge operated by 800-horsepower motor.

Isolated Plant. Interconnection Will Help Coal Situation. Power House, vol. 11, no. 10, Oct. 1918, pp. 294-296. Considerations on practicability of interconnecting isolated plants with central station.

Quarry. The New Modern Rock Crushing Plant of the Brownell Improvement Company. Cement Eng. News, vol. 36, no. 8, Aug. 1918, pp. 38-39, 1 fig. Quarry operations and details of power plant and electrical features.

Rolling Mills. Electrification of a Steam-Driven Three-High Merchants Mill at the Frodingham Iron and Steel Works. Elecn., vol. 81, no. 2098, Aug. 2, 1918 pp. 297-299, 4 figs. Account of some problems which were solved in making change from steam to electricity.

Statistics of Consumption. Power Consumption of National Industries, L. W. Schmidt, Power, vol. 48, no. 18, Oct. 29, 1918, pp. 628-630. An attempt by author to evolve a scheme according to which power requirements of leading national industries should be measured with a view to facilitating regional distribution and to prevent waste; a statistical table accompanies article.

Waste Heat. The Utilization of Waste Heat from Open-Hearth Furnaces for the Generation of Steam, Thomas B. Mackenzie. Iron & Coal Trades Rev., vol. 97, no. 2637, Sept. 13, 1918, pp. 286-289, 4 figs. Paper before Iron & Steel Inst., Sept. 1918.

Water Power. Power Possibilities in California, F. H. Fowler. Jl. of Elec., vol. 41, no. 9, Nov. 1, 1918, pp. 393-395, 2 figs. Survey of streams indicating where maximum development has already been reached, drawbacks of certain localities and advantages of others.

The Energy Supply of North America, C. P. Steinmetz. Elec. News, vol. 27, no. 20, Oct. 17, 1918, pp. 22-24 and 38. Urges conservation of coal and utilization of all possible water powers. Before Am. Inst. Elec. Engrs.

POWER PLANTS

Argentine. Power Supply for the Central Argentine Electrification. Elec. Ry. Jl., vol. 52, no. 15, Oct. 12, 1918, pp. 646-650, 3 figs. Description of steam turbine electric power station supplying traction, lighting and power requirements in suburbs of Buenos Aires. Also in Elec. World, vol. 72, no. 15, Oct. 12, 1918, pp. 684-687, 3 figs.

BOILER ROOM MANAGEMENT

see operation

Boiler Settings. Tight Boiler Settings an Aid to Economy, J. E. McCormack. Power House, vol. 11, no. 10, Oct. 1918, pp. 292-293. Instances under author's observation and suggestions to secure air-tightness.

Costs. Plant Arrangement and Costs of Construction. Elec. World, vol. 72, no. 17, Oct. 26, 1918, pp. 780-782, 4 figs. Features of latest station of Turners Falls Power & Electric Company, Chicopee Junction, Mass. (First article.)

Engine Economy. Increasing Engine Economy, M. A. Saller. Power Plant Eng., vol. 22, no. 21, Nov. 1, 1918, pp. 870-873, 7 figs. Effects on capacity and efficiency of running engine condensing. (Fourth article.)

Floods. The Power Station at Millers Ford. Elec. Rev., vol. 73, no. 16, Oct. 19, 1918, pp. 605-608, 7 figs. Description of features of new steam-electric power plant of Dayton Power Light Co. Precautions against floods.

Hydro-electric. Fourth Successive Hydro-Electric Plant Nears Completion at Rumford, Maine. Eng. News-Rec., vol. 81, no. 15, Oct. 10, 1918, pp. 654-657, 6 figs. Development, begun in 1892, has increased from 200 to 300,000 hp. Description with map and sketches of the new work.

Malamort Electric Power House (L'usine électric de Malamort), A. Boudreau. Revue Générale de l'Electricité, year 29, nos. 15-16, Aug. 24, 1918, pp. 270-274, 6 figs. Account of development of hydro-electric power station.

New Hydro-electric Plant of Montana Power Company, W. A. Scott. Elec. Rev., vol. 73, no. 14, Oct. 5, 1918, pp. 535-537, 2 figs. (Second article.)

INSTRUMENTS

see operation

Operation. Arrangements to Avoid Operating Difficulties. Elec. World, vol. 72, no. 16, Oct. 19, 1918, pp. 732-734, 8 figs. Description of a plant in Dayton, Ohio, in which special attention has been given to handling coal economically, obtaining clean intake water, providing flexible piping layout and furnishing adequate boiler-room instruments.

Boiler-Room Management Plan, T. N. Wynee. Elec. World, vol. 72, no. 12, Sept. 21, 1918, pp. 549-552, 5 figs. How fifty to one hundred thousand dollars is saved annually by Indianapolis Company in trained boiler-room men and in adequate boiler-room equipment. From paper before Indiana Electric Light Assn., Aug. 1918.

Power Plant Management; The Use of Instruments, Robert June. Power House, vol. 11, no. 10. Oct. 1918, pp. 281-283, 7 figs. Summary of best current practice.

The Millers Ford Station. Power Plant Eng., vol. 22, no. 20, Oct. 15, 1918, pp. 825-831, 10 figs. Unique method of handling condenser water, flood protection; electrical layout; description of steam-electric plant at Dayton, O.

Waterworks Operation. Mun. Jl., vol. 45, no. 17, Oct. 26, 1918, pp. 322-324. Using record; for increasing efficiency; analyzing flue gases; soot blowers; steam jets; chain grate, overfeed and underfeed stokers.

Power Factors. Getting the Maximum Out of Equipment, Will Brown. Elec. World, vol. 72, no. 17, Oct. 26, 1918, pp. 791-793, 1 fig. The power producer and the user must co-operate in order to improve power factor, otherwise adequate power to meet essential needs may not be available in approaching winter; remedy readily applicable.

Power-Factor Correction, an Urgent Necessity, Will Brown. Elec. World, vol. 72, no. 18, Nov. 2, 1918, pp. 834-837, 1 fig. Overlapping of fall lighting and power loads together with fuel scarcity may curtail power unless power factor is improved; causes of low power factor, how to locate them and the proper remedies to apply.

Soot in Boiler Tubes. Keeping Boiler Tubes Free From Soot, W. Saller. Power House, vo. 11, no. 10, Oct. 1918, p. 297. Effect of soot accumulation on boiler efficiency.

Turbo-Electric. A New 25,000 kw. Power Plant for Dayton, Ohio. Power, vol. 48, no. 18, Oct. 29, 1918, pp. 620-624, 3 figs. Principal data and description on new turbo-electric plant.

Detailed Description of Recently Installed 45,000-kw. Turbine Generators, J. P. Rigsby. Elec. News, vol. 27, no. 20, Oct. 15, 1918, pp. 28-30. Westinghouse cross-compound, bouble-unit type, consisting of a high and low pressure turbine each connected through a fixible coupling to its own generator, mounted on separate bedplates supported on foundations lying parallel to each other.

Water Softening. Use of Soda Ash in Water Softening. William Henry Hobbs. Ry. Rev., vol. 63, no. 18, Nov. 2, 1918, pp. 633-635. Emphasizes importance of accuracy in adjusting treatment to individual needs.

POWER TRANSMISSION

Belting. Textile Belting for Driving and Conveying, A. Chadwick. India-Rubber, Jl., vol. 56, no. 14, Oct. 5, 1918, pp. 1-5, 4 figs. Manufacture of sewn cotton ducks, balata, solid woven cotton, and solid woven hair belting. Before Lancashire Section of Textile Industry.

Magnetic Gearing. Magnetic Gearing Arrangement (Quelques dispositifs d'embrayage magnétique). Revue Générale de l'Electricité, vol. 4, no. 10, Sept. 7, 1918, pp. 354-356, 5 figs. Principle of operation and scheme of connections of an automatic differential type.

PRODUCER GAS AND GAS PRODUCERS

Wood Gasification. Some Data of Tests on Wood Gasification in Inclined Retorts in Sweden (Einige Mitteliumgen über Versuche mit Holzvergasung in genaiggen Retorten bei vartagasverket in Stockholm, Schweden), Adolf Molin. Journal für Gasbeleuchung, year 61, no. 5, Feb. 2, 1918, pp. 50-55, 5 figs.

PUMPS

Centrifugal. Progress in Water Works Pumping Machinery, L. D. Grisbaum. Fire & Water Eng., vol. 64, no. 12, Sept. 18, 1918, pp. 202-203. Development of centrifugal pumps and their various present uses.

Irrigation. Operating Features of a California Pumping Project. Elec. Rev., vol. 73, no. 14, Oct. 5, 1918, pp. 523-525, 4 figs. Terra Bella irrigation system operated entirely by motor driven pumps supplied by central station.

RAILROAD ENGINEERING, ELECTRIC

Electrification. Railway Electrification to Save Fuel, W. J. Davis. Jl. of Elec., vol. 41, no. 9, Nov. 1, 1918, pp. 411-412. Figures bringing out loss of fuel which results from present method of making each engine a power plant in itself.

Power House. Electrification of the Central Argentine Railway. Power, vol. 48, no. 16, Oct. 15, 1918, pp. 550-554, 5 figs. Details of power house and equipment.

Rolling Stock. Efficient and Systematic Maintenance Prolongs Life of Rolling Stock and Reduces Operating Costs. Elec. Ry. Jl., vol. 52, no. 14, Oct. 5, 1918, pp. 622-623, 5 figs. Account of methods of Evanston, Ill., Railway in cutting power costs and increasing fare collections.

Heavy Electric Traction on the Central Argentine. Elec. Ry., vol. 52, no. 14, Oct. 5, 1918, pp. 604-609, 7 figs. Details of rolling stock, power and brake control, collecting shoe and conducting rail.

SUBURBAN LINES. Electric Railways in Argentina. [illegible] Oct. 1918, pp. 208-209, 3 figs. Details of [illegible] Central Argentine [illegible]

TRACK SWITCHES, AUTOMATIC. Automatic Track Switches, Railways [illegible] Work, R. C. Cram. Elec. Ry. Jl., vol. 52, no. 16, Oct. 19, 1918, pp. [illegible], 18 figs. Study of development and present status of automatic and [illegible] control track switches with consideration of factors which have contributed to their evolution.

UNIVERSAL CARS. The First Universal Car. [illegible] no. 17, Oct. 26, 1918, pp. 729-730, 1 fig. [illegible] submitted by War Board to Housing Bureau.

RAILROAD ENGINEERING, STEAM

ALASKA. Railroad Construction Progress in Alaska. Ry. Rev., vol. 63, nos. 14 and 15, Oct. 5 and 12, 1918, pp. 487-490, 7 figs., and 537-540, 7 figs. Line between Seward and Anchorage completed; work on other sections well advanced.

BOILERS. Constructing Locomotive Boilers and Fire-boxes. Ry. Gaz., vol. 29, no. 12, Sept. 20, 1918, pp. 311-312, 2 figs. [illegible]

BRAZIL. The Development of the Brazilian Railways Ry. Age. vol. 65, no. 16, Oct. 18, 1918, pp. 701-704, 4 figs. Statistics of Brazilian railways. Brazil presented as important potential market for American railway supply [illegible] statistics of imports of railway equipment.

BRAKES. Importance of High-Speed Brakes in Railroad Operation (l'importance des freins rapides dans l'exploitation des chemins de fer), J. Cablier. Revue Générale de l'Electricité, vol. 4, no. 10, Sept. 7, 1918, pp. 351-352. Comparison of interest and amortization of involved expense with benefit derived in transportation service.

CARS. U. S. R. A. Standard Baggage Car. Ry. Mech. Eng., vol. 92, no. 10, Oct. 1918, pp. 561-563, 6 figs. Description of 60-ft. and 70-ft. all-steel baggage car constructed for U. S. Railroad Administration.

DRAFT GEARS. Draft Gears Should Be Maintained, L. T. Canfield. Ry. Mech. Eng., vol. 92, no. 10, Oct. 1918, pp. 565-567, 2 figs. Proper protection to car and to lading requires a system of periodical inspection and repairs.

FIREBOXES. The Belpaire Firebox. Ry. Gaz., vol. 29, no. 12, Sept. 20, 1918, p. 308, 3 figs. Account of American experience with that type and subsequent design modifications required.

HEATING, TRAIN. The Coal Saving Problem and Train Heating. Ry. Gaz., vol. 29, no. 15, Oct. 11, 1918, pp. 383-384, 2 figs. Suggests apparatus for recovering waste heat. Before Instn. Locomotive Engrs.

LOADING. Proper Methods of Loading Automobiles. Ry. Rev., vol. 63, no. 16, Oct. 19, 1918, pp. 565-569, 11 figs. Analysis of methods employed by shippers and a representative railroad.

LOCOMOTIVE CRANK PIN. A Ball Bearing Crank Pin. Ry. Gaz., vol. 29, no. 15, Oct. 11, 1918, p. 385, 2 figs. Application of ball-bearing to crank pin of a 2-10-2 type. From Ry. Mech. Engr.

LOCOMOTIVE FIRING. The Economical Use of Coal in Railway Locomotives. University of Ill. Bul., vol. 16, no. 2, Sept. 9, 1918, 71 pp., 17 figs. Statement of facts concerning choice, distribution, storage, and use of coal, ans suggestions intended to supplement efforts of railway men to save coal.

LOCOMOTIVE VALVE GEAR. A New Locomotive Valve Gear. Ry. Gaz., vcl. 29, no. 14, Oct. 4, 1918, p. 359, 1 fig. Motion of valve same as obtained with Stephenson gear, but eccentric motion work removed from between frames and applied to outside using double crank arm as substitute for eccentrics and straps.

LOCOMOTIVES. First Standard 0-8-0 Switcher. Ry. Mech. Eng., vol. 92, no. 10, Oct. 1918, pp. 543-545, 5 figs. Description and principal data of standard switcher built for U. S. Railroad Administration. Also in Ry. Rev., vol. 63, no. 14, Oct 5, 1918, pp. 513-515, 4 figs.

4-6-0 Passenger and Double Bogie Tender, London South-Western Railway. Ry. Engr., vol. 39, no. 465, Oct. 1918, pp. 184-186, 2 figs. Dimensions of cylinders, wheels, valve gear, boiler, heating surface, and weights. Also in Ry. Gaz., vol. 29, no. 14, Oct. 4, 1918, p. 361, 1 fig.

4-6-2- Locomotive. Philadelphia & Reading Railway. Ry. Gaz., vol. 29, no. 15, Oct. 11, 1918, p. 387, 1 fig. Features and dimensions.

Heavy Mallet Compound for Virginian Railway. Ry. Rev., vols. 63 and 65, nos. 14 and 16, Oct. 5 and 18, 1918, pp. 497-498 and 688-691, 3 figs. General description with principal data.

Modern Locomotive Engine Design and Construction (XLII). Ry. Engr., vol. 39, no. 465, Oct. 1918, pp. 187-191, 4 figs. Effect of superheating on both steam and fuel consumption at various rates of expansion.

Pacific Type Locomotives for the Central of New Jersey. Ry. Age, vol. 65, no. 18, Nov. 1, 1918, pp. 769-770, 1 fig. Description and principal data.

U. S. R. A. Standard Six-Wheel Switching Locomotive. Ry. Age, vol. 65, no. 15, Oct. 11, 1918, pp. 655-657, 3 figs. Principal data, drawings and tonnage chart, with general description of smallest government engines.

LONG FORK RAILROAD. The B. & O. Completes the Long Fork Railway, A. C. Clark. Ry. Age, vol. 65, no. 15, Oct. 11, 1918, pp. 663-665, 5 figs. Description of new line which is important step in development of coal resources of Kentucky.

OPERATION. Difficulties in Handling French Equipment, J. N. McVey. Ry. Rev., vol. 63, no. 16, Oct. 19, 1918, pp. 581-584. Trials encountered by Amer. Ry. Engrs. in handling foreign equipment.

PERMANENT WAY. Stresses in Permanent Way. Ry. Engr., vol. 39, no. 465, Oct. 1918, pp. 191-194, 8 figs. Report of extensive tests made on two lines in United States, on various sections. (Continuation of serial.)

RAILS. A Metallographic [illegible] with Special Reference to High-Phosphorus Streaks, G. F. Comstock. Bul. Am. Inst. Min. Engrs., no. 143, Nov. 1918, pp. 1699-1714, 17 figs. Experimental research of [illegible] result of fatigue of steel, and (2) that they are originated from a defect on steel

Common Defects [illegible] 1918, pp. 498-501. From paper by C. W. Gennet before convention of Roadmasters & Maintenance of Way Assn., Chicago, Sept. 1918.

Relative [illegible] Open-Hearth Rail on Curves, H. W. Roberts. Elec. Ry. Jl., vol. 52, no. 16, Oct. 19, 1918, p. 697. Results of [illegible] open hearth.

[illegible] by various authors. Before Am. Elec. Chem. Soc.

RATES. [illegible] vol. 17, no. 2, Sept. 1918, pp. 19-26. Methods of economics as applied to engineering; comparison of [illegible]

RESISTANCE. The Mechanics of Curved Resistance. Ry. Rev., vol. 63, no. 15, Oct. 12, 1918, pp. 527-531, 2 figs. A study, covering older theories with data of recent experiments. From paper by J. G. Sullivan contributed to Bulletin 207 of Am. Ry. Eng. Association. Also in Ry. Age, vol. 65, no. 15, Oct. 11, 1918, pp. 665-666.

SHOP OPERATIONS. Machining Locomotive Driving Boxes, Frank A. Stanley. Ry. Mech. Eng., vol. 92, no. 10, Oct. 1918, pp. 573-575, 11 figs. Outline of work as performed at the Sacramento shops of Southern Pacific.

SHOPS. New Devices in Soo Wheel Shop. Ry. Mech. Eng., vol. 92, no. 10, 1918, pp. 577-579, 5 figs. Shifting platforms at press and automatic discharging axle carrier add to efficiency of plant.

The Manufacture of Laminated Springs. Ry. Gaz., vol. 29, no. 15, Oct. 11, 1918, pp. 388-390, 4 figs. General layout of locomotive smithy and steam hammer shops.

SIGNALING. New Electric Interlocking at Clyde, Ill. Ry. Signal Engr., vol. 11, no. 10, Oct. 1918, pp. 306-307, 5 figs. Plant on Chicago, Burlington & Quincy for handling increased main line and yard movement due to heavier traffic.

TENDERS. New Tender for Canadian Pacific Locomotives. Ry. Rev., vol. 63, no.15 Oct. 12, 1918, pp. 525-526, 2 figs. Dimensioned drawing and general description.

TIES. Present Aspect of the Tie Situation. Ry. Rev., vol. 63, no. 14, Oct. 5, 1918, pp. 494-495. Principles governing buying and specification of cross ties and difficulties of correct price fixing. From remarks by John Foley at Annual Roadmasters' convention, Chicago, Sept. 1918.

Reinforced Concrete Ties on Southern Pacific. Ry. Rev., vol. 63, no. 16, Oct. 19, 1918, pp. 557-558, 4 figs. Practical solution of problem faced in present-day shortage of wooden ties.

FRENCH EQUIPMENT

See Operation.

REFRACTORIES

SILICA BRICKS. The Manufacture of Silica Brick, H. Le Chatelier and B. Bogitch. Can. Min. Jl., vol. 39, no. 18, Sept. 1918, pp. 314-317. Causes of failure of furnace roofs; why silica brick retains rigidity at high temperature; manufacturing operations. Paper before Am. Inst. of Min. Engineers, Milwaukee.

TESTS. The Standardization of Tests for Refractory Materials, Cosmo Johns. Iron & Steel Inst., advance copy, paper, 11, Sept. 12-13, 1918, 32 pp., 3 figs. Analysis of fire clays, raw ganisters, quartose, rocks and manufactured products; analysis of dolomite and magnesite identification of the various forms of silica in silica bricks; porosity, water absorption and specific gravity tests; shrinkage of clays on drying and firing; tensile strength of dried clays; refractoriness and crushing strength. Prepared provisionally by a committee of refractories section of Ceramic Society.

REFRIGERATION

REFRIGERATING PLANT, A. E. F. Refregerating Plant, Intermediate Depot for American Army in France, Robert K. Tomlin, Jr. Power, vol. 48, no. 17, Oct. 22, 1918, pp. 596-598, 4 figs. Description of plant to care for 5000 tons of meat.

THROTTLING OF AMMONIA. Throttling of Ammonia, Charles H. Herter. Power, vol. 48, no. 15, Oct. 15, 1918, pp. 530-531. Discusses question of whether it is better to regulate several expansion valves singly, or main liquad valve at receiver.

RESEARCH

BRITISH COMMITTEE. Scientific and Industrial Research. Third Annual Report. Iron & Coal Trades Rev., vol. 97, no. 2636, Sept. 6, 1918, pp. 257. Report of Committee of Privy Council for Scientific and Industrial Research.

BRITISH NATIONAL PHYSICAL LABORATORY. Research the Mainstay of a Nation's Industries, Richard T. Glazebrook. Can. Machy., vol. 22, no. 16, Oct. 17, 1918, pp. 449-454, 5 figs. Work accomplished by Nat. Research Lab. of England.

The British National Physical Laboratory. Sci., vol. 48, no. 1238, Sept. 20, 1918, pp. 284-287. Brief report of work done during past year in electricity, heat, meteorology aero-dynamics and special research and investigations.

COTTON MANUFACTURERS' COMMITTEE. Committee on Industrial Research Textile World Jl., vol. 54, no. 19, Nov. 9, 1918, pp. 117-118. Report of committee of Nat. Assn. of Cotton Mfrs. on possibilities of research along lines connected with cotton manufacturing industry and best methods to carry it out.

ROADS AND PAVEMENTS

Asphalt. Maintaining Old Asphalt Pavements in Buffalo, C. L. P. Babcock and J. A. Vandewater. Can. Engr., vol. 35, no. 15, Oct. 10, 1918, pp. 325 and 331-332, 2 figs. Average costs of repairs per yard at different ages to date of condemnation. Before Am. Soc. Mun. Improvements.

Cracks. The Prevention of Longitudinal Cracks in Hard-Surfaced Pavements, Wm. C. Perkins. Good Roads, vol. 16, no. 17, Oct. 26, 1918, pp. 158 and 161. Description of patented method of constructing foundations for brick, concrete and other surfacing. Before Am. Soc. Mun. Improvements.

Drainage. Drainage—The Most Important Consideration Entering into Road Construction, J. H. MacDonald. Can. Engr., vol. 35, no. 15, Oct. 10, 1918, pp. 327-329 and (discussion) pp. 329-331. Salient features of this question from local investigations. Before Fifth Annual Congress Can. Good Roads Assn.

The Maintenance of Drainage, R. A. Meeker. Good Roads, vol. 16, no. 12, Sept. 21, 1918, pp. 107-108, 2 figs. Its importance in care of roadway.

Fillers. The Choice of Fillers for Block Pavements, John S. Crandell. Mun. & County Eng., vol. 55, no. 4, Oct. 1918, pp. 127-130, 5 figs. Types of fillers; functions of a filler; granite block pavement.

Macadam. American Road Building in French War Zone Organized, Robert K. Tomlin. Highway Mag., vol. 9, no. 6, July 1918, pp. 1-3 and 6, 1 fig. Development of Methods of constructing water-bound macadam from inspection by United States highway engineers of British and French Systems.

Maintenance Work. How Well-Maintained Roads are Secured, D. H. Winslow and Charles R. Thomas. Am. City, vol. 19, no. 4, Oct. 1918, pp. 266-270, 4 figs. Study of comparative benefits of local and central government in developing good roads, with special reference to North Carolina system of road maintenance.

Organization for Road Maintenance, L. H. Neilsen. Good Roads, vol. 16, no. 17, Oct. 26, 1916, pp. 157-158. Discussion of administration and operation of maintenance work in Michigan, with special reference to patrol system in township. Before Mich. State Good Roads Assn.

Pavement Cleaning and Maintenance. Mun. & County Eng., vol. 55, no. 4, Oct. 1918, pp. 147-155. Preservative effects of macadam surface treatments applied as dust layers; procedure in maintenance of asphalt pavements in Buffalo; data on performance of motor apparatus operated by bureau of streets; relative efficiency of methods for repairing bituminous macadam and bituminous concrete pavements.

Motorized Equipment. The Motor Truck and Trailer in Road and Street Building, Repair and Maintenance. Cement Eng. News, vol. 30, no. 8, Aug. 1918, pp. 24-28. Data taken from records in office of a county engineer.

Philippines. Highway Work in the Philippines. Good Roads, vol. 16, no. 17, Oct. 26, 1918, pp. 155-156, 4 figs. Summary of operations of Bureau of Public Works in 1917 and Notes on Road Conditions and Traffic.

Repairs. War-Time Road Repairs. Am. City, vol. 19, no. 4, Oct. 1918, pp. 259-261, 2 figs. Necessity of repairing roads and manner of keeping an earth road in satisfactory condition.

Rural Roads. Road Construction in Alberta, J. D. Robertson. Can. Engr., vol. 35, no. 13, Sept. 26, 1918, pp. 285-286. Experience in province with rural roads of sand, gravel, etc. Before Eng. Inst. of Can.

Slag. Roads During and After the War. E. Purnell Hooley. Can. Engr., vol. 35, no. 12, Sept. 19, 1918, pp. 265-266. Use of furnace slag as surface course. Before Instn. Mun. & County Engrs.

SAFETY ENGINEERING

Accidents. Accident Prevention and Safety, a list of new books and articles received in the library of the National Workmen's Compensation Service Bureau, New York, September, 1918, 9 pp.

Foundation for the Assumption that 18 per cent of Industrial Accidents are Due to Defects in Lighting Installation, R. E. Simpson. Am. Gas Eng. Jl., vol. 109, no. 16, Oct. 19, 1918, pp. 364-366. Based on Travelers Insurance Co. records.

Works Accidents, Their Causes and Remedies. Can. Foundryman, vol. 9, no. 8, Aug. 1918, p. 175. Brief account of investigation conducted on behalf of the Health of Munition Workers' Committee.

Construction Work. Precautions for Reducing Accidents on Construction Work, W. J. Lynch. Can. Engr., vol. 35, no. 18, Oct. 31, 1918, p. 398. Before Construction Section of Nat. Safety Congress.

Dangerous Tools. Dangerous Tools and Appliances, Chesla C. Sherlock. Am. Mach., vol. 49, no. 16, Oct. 17, 1918, pp. 705-707. Review of some court findings on liability of employers.

Explosives. Handling and Storing Explosives, Arthur La Motte, Eng. & Min. Jl., vol. 106, no. 11, Sept. 14, 1918, pp. 488-493. (Nat. Safety Council.)

Fire Protection. Fire Protection of Turbo-Alternators (Protection contre les incendies de turbo-alternateurs), L. Conge. Revue Générale de l'Electricité, vol. 4, no. 10, Aug. 31, 1918, p. 322, 3 figs. Details of method permitting fire extinction by steam jet under pressure.

How Some Important Ship Fires were Fought, with Notes on Tools for Marine Fire-Fighting, Edward J. Worth. Quarterly of Nat. Fire Prevention Assn., vol. 12, no. 2, Oct. 1918, pp. 143-149. Before International Assn. of Fire Engrs.

Maintenance of Sprinkler Equipment during Cold Weather in Western Canada, John Young. Quarterly of Nat. Fire Protection Assn., vol. 12, no. 2, Oct. 1918, pp. 157-159. Practice in layout of water mains and of heating gravity tanks.

Oil Interrupters and Fire Protection (les interrupteurs à huile et la protection contre l'incendie), P. Torche. Revue Générale de l'Electricity, vol. 4, nos. 9 and 10, Aug. 31 and Sept. 7, 1918, pp. 311-319, 4 figs. and pp. 343-348, 2 figs. Aug. 31: Résumé of tests on interrupters undertaken by the Association Suisse des Electriciens for the purpose of establishing rules for construction use and installation of these apparatus. Sept. 7: Causes of explosion and analysis of American piston type, which, in author's opinion, is the only one safe against internal pressure.

Shipyard Fire Protection. Quarterly of Nat. Fire Protection Assn., vol. 12, no. 2, Oct. 1918, pp. 126-128. Notes on the organization of the Plant Protection Section of the Am. Fleet Corporation.

The Fire Risk on Vessels, Samuel D. McComb. Quarterly of Nat. Fire Protection Assn., vol. 12, no. 2, Oct. 1918, pp. 133-142, 2 figs. Study of hazards of marine transportation. From the Weekly Underwriter.

Grinding Wheels. Bursting Grinding Wheels, Chesla C. Sherlock. Am. Mach., vol. 49, no. 17, Oct. 24, 1918, pp. 767-769. Decisions of courts under various circumstances.

Health Conditions. Health of English Workmen in Munition Factories (de la santé des travailleurs anglais dans les usines de munitions.) Revue Générale de l'Electricité, year 29, nos. 15-16, Aug. 15-30, 1918, pp. 451-452. Brief account of report of special committee appointed by British Government to study health conditions in industries.

Mine Rescue. Mine Rescue Apparatus. Engineer, vol. 126, no. 3272, Sept. 13, 1918, pp. 219-220, 4 figs. Report of a committee appointed to investigate types of breathing apparatus used in coal mines.

Punch Presses. Safe Punch Press Operation, W. W. Roach. Iron Age, vol. 102, no. 18, Oct. 31, 1918, pp. 1076-1077. Elimination of cuts and lacerations; mechanical guards; lighting and arrangement of machinery; safe practices. Paper before National Safety Council, St. Louis, Sept. 1918.

Spontaneous Heating. Spontaneous Heating of Grain and other Foodstuffs (Ueber die Selbsterhitzung von Getreiden und anderen Nahrstoffen), J. F. Hoffman. Dinglers polytechnisches Journal, vol. 333, no. 8, Apr. 20, 1918, pp. 63-67, 1 fig.

Water Mains. Leakage from High-Pressure Mains and its Variation with the Pressure. Can. Engr., vol. 34, no. 13, Sept. 26, 1918, pp. 286-287, 1 fig. Report of service in fire system of Borough of Manhattan. From Jl. Am. Waterworks Assn.

Protection of Water Mains, Fire Hydrants and Valves in Winnipeg, Thomas H. Hooper. Quarterly of Nat. Fire Protection Assn., vol. 12, no. 2, Oct. 1918, pp. 159-160.

SANITARY ENGINEERING

Disinfection. Disinfection by Heat. Times Eng. Supp., no. 528, Oct. 1918, p. 207. Type of disinfectors; suggestions on conditions to be observed.

Drainage. Main Drainage and its Relation to River and Harbor Front Improvement, Morris Knowles and J. M. Rice. Can. Engr., vol. 35, no. 14, Oct. 3, 1918, pp. 297-302 and 318. Résumé of methods adopted in many of world's leading cities with detailed notes regarding design of Essex border interceptor. Before Am. Soc. of Mun. Improvements.

Refuse Disposal. Refuse incinerating Plants and their Operation, H. J. Harder. Mun. Jl., vol. 45, no. 17, Oct. 26, 1918, pp. 318-320. Tables giving name of city, capacity and other details of plant, and total cost per day.

Sanitary Engineering. The Why and Wherefore of Sanitary Engineering, Arthur Bateman. Domestic Eng., vol. 85, no. 1, Oct. 5, 1918, pp. 5-7 and 32, 4 figs. Series on technical and scientific plumbing and sanitation.

Sanitation of Grounds. The Sanitation of Rural Workmen's Areas. Am. City, vol. 18, no. 4, Oct. 1918, pp. 275-278, 2 figs. Shows how to insure suitable living conditions for war-time industrial workers. From report of United States Public Health Service.

Sewage. Catch-Basin Cleaning. Can. Engr., vol. 35, no. 13, Sept. 1918, pp. 287-288. Annual report of superintendent of Bureau of Sewers, Chicago.

First Unit of Improved Means of Sewage Disposal for Philadelphia Well Started, W. L. Stevenson. Eng. News-Rec., vol. 81, no. 14, Oct. 3, 1918, pp. 629-633, 3 figs. Design features include intercepting sewer partly under pressure, ventilated grit chamber with sand-removing and washing plant, and depressed Venturi meter.

Main Sewage Treatment Plant of Rochester, E. A. Fisher and N. A. Brown. Mun. Jl., vol. 45, no. 17, Oct. 26, 1918, pp. 326-329. Description and operating data of detritus tanks, Riensch-Wurl screens. Imhoff tanks, sludge beds and power plant. Before Am. Soc. Mun. Improvements.

Miles Acid Treatment of Sewage. Mun. Jl., vol. 45, no. 17, Oct. 26, 1918, 321-322. Conclusion of report upon experiment with this process.

Operating Sewage Plants. Mun. Jl., vol. 45, no. 17, Oct. 26, 1918 pp. 327-328. Abstract of instructions issued by Texas State Board of Health: tank, sludge beds, filters, activated sludge: operation records.

Sewage Purification by Activated Sludge Process, W. R. Copeland. Can. Engr., vol. 35, no. 14, Oct. 3, 1918, pp. 302 and 315-316. Comparative degrees of purification obtained with different quantities of air.

Sewer Design and Construction. Mun. & County Eng., vol. 55, no. 4, Oct. 1918, pp. 130-132, 1 fig. Sewage collection and disposal proposed at Los Angeles harbor; conditions calling for separate or combined sewers.

The Private Sewerage Question, D. H. Wyatt. Can. Engr., vol. 35, no. 14, Oct. 3, 1918, pp. 310-311. Results produced by leaky building drain sand building sewers.

Uses and Accomplishments of Chlorine Compounds in Water and Sewage Purification, C. A. Jennings. Am. City, vol. 19, no. 4, Oct. 1918, pp. 296-304, 3 figs. Remarks on comparative value of liquid chlorine and hypochlorite for disinfection of water and sewage.

Water Purification and Sewage Treatment. Mun. & County Eng., vol. 55, no. 4, Oct. 1918, pp. 138-143, 8 figs. Prevention of Imhoff tank foaming at Schenectady; design and construction features of the slow sand water filtration plant at Auburn; chlorination and filtration.

Water Pollution. Salinification of Rivers and Elimination of Waste Liquids from Soda Works (Die Versalzung der Flüsse und die Beseitigung der Kaliabwasser, Journal fur Gasbaeleuchtung, year 61, no. 19, May 11, 1918, pp. 221-221.

Pollution of Boundary Waters, F. A. Dallyn. Can. Engr., vol. 35, no. 15, Oct. 1918, pp. 323-325. Examination of final report of International Joint Commission. Before Am. Soc. Mun. Improvements.

STANDARDS AND STANDARDIZATION

Aircraft Materials. British Engineering Standards Association. Aeronautics, vol. 15, no. 255, Sept. 4, 1918, pp. 224-226. Report regarding standardization of aircraft materials and parts.

Gearing. Standardization of Gearing, B. F. Waterman. Mech. World, vol. 64, no. 1645, July 12, 1918, pp. 14-15. Outline of details which author thinks may be standardized in each type. (Am. Gear Mfrs. Assn. Convention.)

Lamp Voltages. The Standardization of Lamp Voltages, Leon Gaster. Illuminating Engr., vol. 11, no. 7, July 1918, p. 170. Announcement of Tungsten Lamp Assn. proposing simplification in that respect.

STEAM ENGINEERING

Boiler Furnace Walls. New data on Boiler Walls, J. C. Taylor, Nat. Engr., vol. 22, no. 9, Sept. 1918, pp. 408-409. Dominant factors in erection and operation of Boiler-furnace walls.

Boilers. Boiler Room Efficiency, A. H. Blackburn. Publicity Mtg., vol. 17, no. 5, Sept. 1918, pp. 7 and 12-13. Suggestions for intensive fuel economy. Paper before Smoke Prevention Assn.

Development of Steam-Boiler Baffles, Albert A. Straub. Power, vol. 48, no. 19, Nov. 5, 1918, pp. 656-659, 9 figs. Examples of baffles developed to obtain maximum economy and capacity consistent with the primary features for which the baffle was designed.

Feeding and Circulating the Water in Steam Boilers, John Watson. Page's Eng. Weekly, vol. 33, no. 735, Oct. 11, 1918, pp. 172-174. Survey of devices developed in recent years. Before Inst. Marine Engrs.

Removing Tubes, Headers and Baffles in Water-Tube Boilers. Power, vol. 48, no. 17, Oct. 22, 1918, pp. 584-590, 12 figs. Detailed directions with illustrations telling how to take out tubes of water-tube boilers, how to put them in, how to go about removing and replacing cast-iron and wrought-iron tube headers and what must be done to put in new brick for the baffling in the tubes.

Condensers. Keeping Condenser Performance up to the Mark, Hartley Le H. Smith. Elec. Ry. Jl., vol. 52, no. 16, Oct. 19, 1918, pp. 694-697, 4 figs. How station engineer can determine economy he should obtain and how he can correct causes of low vacuum.

Economizers. Economizers from the Viewpoint of a Designing and Operating Engineer, Louis R. Lee. Power, vol. 48, no. 18, Oct. 29, 1918, pp. 637-638, 1 fig.

Wear and Tear on Fuel Economizers, Edward Ingham. Colliery Guardian, Oct. 4, 1918, vol. 96, no. 3014, pp. 707. External corrosion; internal corrosion; water hammer; overheating; flue gas explosions; importance of frequent examinations.

Exhaust Steam. Using Exhaust Steam, S. E. Balcome. Power Plant, Eng., vol. 22, no. 20, Oct. 15, 1918, pp. 832-835, 3 figs. Value of exhaust steam; limitations of its use; effects of engine efficiency; heat available with various types of engines.

Pumping Engines. Pumping Engines for the Cairo Main Drainage. Engineering, vol. 106, no. 2749, Sept. 6, 1918, pp. 251-252, 9 figs. Drawings of details a general description of quadruple expansion engines.

Steam Turbine Development and Tendencies. Elec. Rev., vol. 73, no. 16, Oct. 10, 1918, pp. 612-614, 3 figs. Rapid development of turbine in past giving place to gradual developments affecting economy ,reliability, safety and increased capacity.

Turbines. Steam Turbines for Natural Steam Power Plant at Larderello, Italy. Engineering, vol. 106, no. 2752, Sept. 27, 1918, pp. 339, 14 figs. General description with drawings and illustrations.

STEEL AND IRON

Under Open-Hearth Furnace — look up page nos. in Iron & Coal Trades Rev.

Acid Resisting Irons. Acid Resisting Irons. Can. Foundryman, vol. 9, no. 8, Aug. 1918, p. 178. Properties and uses of silicon alloys; typical analysis of duriron and tantiron. (See also Tantiron.)

Cast Iron. A Method for the Prevention of Growth in Grey Cast Iron, J. E. Hurst. Iron & Steel Inst., advance copy, paper 10, Sept. 12-13, 1918, 5 pp., 3 figs. Investigation of possibility of removing graphite without subsequent production of cavities in metal by superficial decarburization, oxidation of graphite being followed by liquation of phosphide entectic with remaining cavities. Also in Iron & Coal Trades Rev., vol. 97, no. 2638, Sept. 20, 1918, p. 323. Paper before Iron & Steel Inst., Sept. 1918.

Avoiding Shrinkage Troubles in Cast Iron. Can Foundryman, vol. 11, no. 9, Oct. 1918, p. 264. Suggestions of some foundrymen regarding use of riser on top of casting to provide sufficient metal to prevent shrinking.

Influence of Some Special Constituents on Cast Iron, A. Campion. Foundry Trade Jl., vol. 20, no. 201, Sept. 1918 ,pp. 467-470. Nickel, chromium, molybdenum, tungsten, boron, and vanadium.

Duriron

See Acid Resisting Irons

Electric Steel. Electric Pig Iron from Steel Scrap, Robert Turnbull. Iron Age, vol. 102, no. 17, Oct. 24, 1918, pp. 1026-1027. Paper before Am. Electrochemical Soc., Atlantic City, Oct. 1918.

Electric Steel Making, Arthur V. Farr. Am. Mach., vol. 49, no. 17, Oct. 24, 1918, pp. 753-755, 4 figs. Describing process of making steel electrically and giving analysis of charge at various stages of process and at end of melt. Paper before Am. Drop Forge Assn., Buffalo, N.Y.,June 1918.

The Electric Furnace in the Steel Cast Industry, W. E. Moore. Elec. Jl., vol. 15, no. 9, Sept. 1918, pp. 331-332. Comparative value of crucible melting open hearth melting ,side-blow converter and electric furnace in producing steel.

Hot Deformation. Influence of Hot-Deformation on the Quantities of Steel, Georges Charpy. Iron & Steel Inst., Sept. 12-13, 1918, advance copy, paper 4, 19 pp., 10 figs. Tensile tests, shock bend tests and notch tests on blooms resulting from three gun metal equal ingots, made in acid furnace and reduced from common original section of 355 x 355 mm., the first to 225 x 225 mm., the second to 165 x 165 mm., and the third to 125 x 125 mm.

Ingots. The Cooling of Steel in Ingot and Other Forms, J. E. Fletcher. Iron & Steel Inst., advance copy, paper 5, Sept. 12-13, 1918, 40 pp., 20 figs. Experimental investigation of laws governing freezing and cooling of steel in metal and sand molds involving the determination of variable speed of cooling, measurements of temperature gredients and contraction, and observations on influence of cooling on crystalline structure. Also in Engineering, vol. 106, no. 2752, Sept. 27, 1918, pp. 342-344, 6 figs.; Iron & Coal Trades Rev., vol. 97, no. 2638, Sept. 20, 1918, pp. 315-318, 9 figs. Abstract of paper before Iron & Steel Inst., Sept. 1918.

Iron Metallurgy. Some Experiments on the Reaction between Pure Carbon Monoxide and Pure Electrolytic Iron below the A 1 Inversion, H. C. H. Car; penter and C. Coldron Smith. Iron & Steel Inst., Sept. 12-13, 1918, advance copy, paper 3, 53 pp., 39 figs. Investigation under two different sets of conditions: (1) those in which gaseous products were removed continuously by passing a stream of carbon monoxide over the iron, and (2) those in which they were allowed to accumulate in apparatus.

Malleable Iron. Phosphorus in Malleable Cast Iron, J. H. Teng. Iron & Steel Inst., advance copy, paper 16, Sept. 12-13, 1918, 19 pp., 13 figs. Experiments at University of Birmingham on two series of test-bars: (1) by adding phosphoric iron to a very pure American washed white iron, (2) by adding the same to iron supplied by Birmingham malleable iron founders.

The Addition of Steel to Cast Iron, J. E. Hurst. Sci. Am. Cupp., vol. 86, no. 2232, Oct. 12, 1918, p. 235. Experiments illustrating absorption of carbon by steel during melting in cupola; results obtained on melting steel borings and crop ends from smithy in a cupola together with 10 per cent ferro silicon. Also in Engineer, vol. 126, no. 3266, Aug. 2, 1918, p. 93.

Open-Hearth Furnace. The Principles of Open-Hearth Furnace Design, Chas. H. F. Bagley. Iron & Steel Inst., Sept. 12-13, 1918, advance copy, paper 1, 19 pp., 5 figs. Discussion from scientific and practical points of view in the light of author's 15 years' experience in England, Germany and United States. Also in Iron & Coal Trades Rev., vol. 97, no. 2637, Sept. 13, 1918, 5 figs.

Pyrometry. Pyrometry Applied to the Hardening of High Speed Steels, J. O. Arnold. Trans. Faraday Soc., vol. 13, part 3, June 1918, 271-275. Results obtained at Sheffield University using an average temperature of 1300 deg. cent.

Quenching. Note on the Warping of Steel through Repeated Quenching, J. H. Whiteley. Iron & Steel Inst., advance copy, paper 17, Sept. 12-13 1918, 4 pp., 7 figs. Photographs showing change of shape of a cylindrical piece, weighing several pounds, which has been used for four years for warming small town after being heated to blood-red heat. Also in Engineering, vol. 106, 2752, Sept. 27, 1918, pp. 340-341, 7 figs.

Spectra. A Comparative Studies of the Flame and Furnace Spectra of Iron, G. A. Hemsalech. Lond. Edinburgh & Dublin Phil. Mag., vol. 36, no. 213, Sept. 1918, pp. 209-230, 7 figs. Experimental research leading author to conclude. that iron spectra given by an electric-tube resistance furnace at atmospheric pressure and up to 2400 deg. cent. are caused by action of heat on a chemical compound of the metal and not on the free metal itself, that flame and furnace spectra are identical up to 2400 deg. cent., that the character of spectrum is independento of the nature of Iron compound, and other similar results.

Steel. Composition and Properties of Steels, Howard Ensaw. Am. Mach., vol. 49, no. 15, Oct. 10, 1918, pp. 669-672, 1 fig. Composition of steels used for manufacture of various parts of intricate special machinery, especially airplane engines, requiring materials possessing unusually high tensile strength and shock-resisting qualities.

Iron, Carbon, and Phosphorus, J. E. Stead. Iron & Steel Inst. of Can., vol. 1, no. 8, Sept. 1918, pp. 323-333, 23 figs. Effect of introducing carbon, by cementation, into homogeneous solid solutions of iron and phosphorus; temperature ranges in which free phosphide of iron passes in and out of solid solution in iron. Before Iron & Steel Inst.

Non-Metallic Inclusions: Their Constitution and Occurrence in Steel, Andrew McCance. Iron & Steel of Can. ,vol. 1, no. 9, Oct. 1918, pp. 374-388, 35 figs. Experimental study of part played by inclusions in developing weaknesses and producing defects in steel products. (To be concluded.)

Note on Certain Colored Interference Bonds and the Colors of Tempered Steel, A. Mallock. Proc. Roy. Soc., vol. 94, no. A664, Aug. 1, 1918, pp. 561-566, 2 figs. Scientific explanation of interference phenomena observed with two sheets of gauze when their distance is gradually altered.

The Influence of some Elements on the Tenacity of Basic Steel, with a new Formula for Calculating the Maximum Load from the Composition. Andrew McWilliam. Iron & Steel Inst., advance copy, paper 13, Sept. 12-13, 1918, 13 pp., 3 figs. Formula for sections that would give results near to those obtained on 1-in. round bars normalized, table showing effect of carbon between 0.1 and 0.75. and results of application of formula to certain series of steel.

Tantiron. Tantiron: Am. Acid Resisting Ferr-Silicon Alloy. Can. Machy., vol. 20, no. 17, Oct. 24, 1918, pp. 477-480, 8 figs. Properties, limitations, corrosion, molding and specialties. (See also Acid Resisting Irons.)

Testing. The Applicability of Electrical Resistance Measurements for the Investigation of Iron and Steel (Om anvandbarheten av elektriska motstandstmatningar för undersökning av jarn och stel), R. D. Enlund. Jern-Kontorets Annaler, Nos. 3-4, 1918, pp. 165-221, 46 figs.

The Magnetic Analysis as a Means of Studying the Structure of Iron Alloys, Kôtaro Honda. Iron & Steel Inst., advance copy, paper 9, Sept. 12-13, 1918, 43 pp., 46 figs. Method based on following experimental facts: (1) the intensity of magnetization of simple homogeneous ferro-magnetic substances decreases at first slowly and subsequently more and more rapidly as temperature increases, and it vanishes at the critical temperature; (2) the critical temperature of a ferro-magnetic element or compound is a characteristic of substance independent of external conditions; (3) the magnetic susceptibility of a substance is abruptly changed when it undergoes an allotropic transformation.

[illegible]. A New Note on Bosh [illegible], J. Holmes. Iron & Steel Inst., advance copy, paper 8, Sept. 12-13, 1918, 9 pp., 2 figs. Account of circumstances which led to adoption by author of [illegible] in 1840 [illegible] at Brymbo.

TERMINALS

CHICAGO. The Pennsylvania's New Goods Depot at Chicago. Ry. Gaz., vol. 29, no. 12, Sept. 20, 1918, pp. 304-307, 4 figs. Layout of tracks, general plan of floors and cross-sections.

LARGE CITIES. Urges Study of Unit Operation of Railroad Terminals in Large Cities. Eng. News-Rec., vol. 81, no. 14, Oct. 3, 1918, pp. 615-619. Yards and Terminals Committee, Railway Engineering Assn., presents a special report recommending investigation by representative committees of possibilities of coördinating existing facilities.

ST. PAUL. Engineering at the St. Paul Passenger Terminal. Ry. Rev., vol. 63, no. 17, Oct. 26, 1918, pp. 595-597, 1 fig. New station; elevated tracks eliminating street crossings at grade; coach yard and locomotive terminal.

TORONTO. Toronto Union Station an Imposing Structure. Can. Engr., vol. 35, no. 15, Oct. 10, 1918, pp. 319-321, 6 figs. Brief description of chief sub-contracts.

TESTING AND MEASUREMENT

CELLS, NORMAL. Report on the Weston Normal Cells Exchanged with the Bureau of Standards and the National Physical Laboratory, Jinchi Obata. Department of Communications, Tokyo, Japan, Researches of the Electrotechical Laboratory, no. 70, May 1918, 11 pp., 1 fig. Method of preparation of cell; three series of comparisons; variation in electromotive force of cell after transportation.

DYNAMOMETERS. A 900-Hp. Dynamometer Installation. Automotive Ind., vol. 39, no. 11, Sept. 12, 1918, pp. 449-451, 5 figs. Features relating to water cooling, exhaust disposal and dynamometer tests of mammoth engines in test room of Duesenberg Motors Corp. Also in Aviation, vol. 5, no. 6, Oct. 15, 1918, p. 371, 4 figs.

GASES, TEMPERATURE. Measuring the Temperature of Gases in Boiler Settings. H. Kreisinger and J. F. Barkley. Department of the Interior, Bureau of Mines, bul. 145, 72 pp., 31 figs. Discussion of various sources of error; manipulation of the polentiometer; list of publications on the utilization of coal and lignite.

HARDNESS. A New Method of Obtaining Brinell Hardness, J. G. Ayers. Automotive Ind., vol. 39, no. 11, Sept. 12, 1918, p. 457, 2 figs. Impact substituted for steady pressure to reduce time required for applying test.

Report on Hardness Testing: Relation between Ball Hardness and Scleroscope Hardness, A. F. Shore. Iron & Steel Inst., advance copy, paper 15, Sept. 12-13, 1918, 19 pp., 11 figs. Report of tests performed on a variety of metals both ferrous and non-ferrous, with different states of heat-treatment. Also in Iron & Coal Trades Rev., vol. 97, no. 2639, Sept. 27, 1918, pp. 352-354, 2 figs.

HYGROMETRY. Hygrometry in terms of the Weight of a Film of Gelatine, C. Barns Science, vol. 48, no. 1241, Oct. 11, 1918, pp. 374-376, 2 figs. Adaptation of form of horizontal torsion balance used by author in measuring absolute viscosity of steel to indications of absoption of atmospheric vapors.

INSULATION RESISTANCE. Note on Measuring a Metallic or Insulation Resistance by the Voltmeter Method (Note sur la mesure d'une résistance (Métallique ou d'isolement) par la méthode du voltmètre), Puget. Revue Générale de l'Electricité, vol. 4, no. 10, Sept. 7, 1918, p. 298, 2 figs. Indicates two methods to simplify for workingman calculations involved in application of usual formula $X = R\,\frac{E-v}{v}$, where R is voltmeter resistance, E deviation connecting battery to voltmeter and v deviation with resistance in circuit.

LEAD TESTING. Lead Testing Machine. Can. Machy., vol. 20, no. 17, Oct. 24, 1918, pp. 484-485, 2 figs. Device consists of cast-iron bed machined all over with two parallel dovetail bearings on top.

MANOMETERS. The Krell Manometer, A. A. Merrill. Aviation, vol. 5, no. 7, Nov. 1, 1918, pp. 421-422, 2 figs. Modification of air-laboratory U-type, in which one branch of U is a glass tube set at a small angle and other branch is a large tank.

METRIC SYSTEM. The International Bureau of Weights and Measures. Sci. Am. Supp., vol. 86, no. 2229, Sept. 21, 1918, pp. 186-187. Motives for creation and special features of metric system. From La Nature.

PYROMETERS. The Types and Industrial Uses of Pyrometers. Can. Foundryman, vol. 9, no. 8, Aug. 1918, pp. 179-182, 3 figs. Classification into "contact" and "distant" classes; variation in indications: suitability of different types; location; details of electric circuit; radiation pyrometers.

SAND. Progress Report of Committee on Mechanical Analysis of Sands. Can. Engr., vol. 35, no. 18, Oct. 31, 1918, pp. 387-390. Specifications for standard sieves; methods of making mechanical analysis. From Report of Committee by Am. Water Works Assn.

STEEL SHELL. Physical Tests of Rolled Shell Steel, James J. Mahon. Iron Age, vol. 102, no. 18, Oct. 31, 1918, pp. 1082-1083, 2 figs. Explanation of frequent results at variance with chemical analysis; excessive precipitation of ferrite corrected by heat treatment.

TESTING MACHINE, TENSION AND COMPRESSION. A Novel Tension and Compression Testing Instrument, Frank C. Perkins. Can. Machy., vol. 20, no. 14, Oct. 3, 1918, pp. 391-392, 6 figs. Device, applicable to wide range of specimen sizes, consists of two adjustable frames, each carrying two screws bearing on gage marks on specimen.

THREAD MEASUREMENT. Projection Lantern for Thread Measurement, H. L. Van Keuren and L. C. Gross. Am. Mach., vol. 49, no. 18, Oct. 31, 1918, pp. 805-811, 10 figs. Describing an apparatus developed by the Bureau of Standards.

VOLTAMETERS. The Richards Form Silver Voltameters, Jinchi Obata. Department of Communications, Tokyo, Japan, Researches of the Electrotechnical Laboratory, no. 71, July 1918, 29 pp. 1 fig. Experimental investigation of the anode compilations in the silver voltameter and determination of voltage of Weston normal cell with Richards form silver voltameter.

THERMODYNAMICS

TRANSMISSION CABLES. New Heat Transmission Cables, William R. Jones, Heat. & Vent. Mag., vol. 15, no. 10, Oct. 1918, pp. 36-41. Compilation in tabular form of factors given by leading authorities covering latest types of construction.

TRANSPORTATION

FOREIGN TRANSPORT. Cheap Transport for Farmers and Rural Industries, Frank Dutton. South African Jl. of Industry, vol. 1, no. 12, Aug. 1918, pp. 1089-1105, 8 figs. Discussion of problem and description of possible solution by means of portable rail tracks for tractors.

YARD TRANSFER. Operating Methods of Transfer Railroads. Ry. Rev., vol. 63, no. 14, Oct. 5, 1918, pp. 490-493. Analysis of existing conditions and suggestions for improvement to meet demands of increased traffic. From paper by E. H. Lee contributed to preliminary reports of Committee on Yards and Terminals, Am. Ry. Engrg. Assn., Sept. 1918.

RECLASSIFICATION

TOWER ERECTION. Some Practical Points in Pole and Tower Erection and Support, Charles R. Harte. Elec. Ry. Jl., vol. 52, no. 12, Sept. 21, 1918, pp. 490-494, 11 figs. Particular reference to erection in marshy ground and the procedure in raising steel towers of different types.

PHOTOMICOGRAPHY. A Telescopic Focussing Apparatus for Photomicrography, A. F. Hallimond. Iron & Steel Inst., advance copy, paper 6, Sept. 12-13, 1918, 3 pp., 1 fig. Arrangement for reflecting beam horizontally and so adjusting focus without use of a ground-glass in usual position.

CHAIN CABLES. Memorandum Regarding the Manufacture of Cast-Steel Chain Cables. Steamship, vol. 30, no.3 82, Oct. 1918, pp. 90-91. Report of Committee of Lloyd's Register; summary of previous attempts and present position; testing of cast-steel chains. Also in Practical Engr., vol. 58, no. 1643, Aug. 22, 1918, pp. 91-92. (To be continued.)

SAND BLAST MACHINERY. How to Select Suitable Sand-Blast Equipment, H. D. Gates. Foundry, vol. 46, no. 315, Nov. 1918, pp. 539-545, 12 figs. Results and operation costs should carry greater weight than first price; description of various types. Paper before Am. Foundrymen's Assn., Milwaukee, Oct. 1918.

POLES. A Diffraction Problem, and an Asymptotic Theorem in Bessel's Series, R. Hargreaves. Lond., Edinburgh & Dublin Phil. Mag., vol. 36, no. 212, Aug. 1918, pp. 191-199. Form to solve problem in two dimensions offered as more convenient than Sommerfeld's; also solution in definite integral transformed directly to series of Bessel's functions and trigonometrical functions of problem in three dimensions, which arises when plane of incident wave is not parallel to edge of barrier.

An Abstract of a Report of Tests Carried Out at a South Swedish Cellulose Factory by the Swedish Association of Steam Users (Utdrag ur en rapport öfver afpröfningar verkstallda vid en Sydsvensk cellulosafabrick af södra sveriges angpanneforening). Teknisk Tidskrift, Mekanik, vol. 48, no. 9, Sept. 1918, pp. 101-114, 7 figs.

Numbering of Pole Line Structures. Elec. Rev., vol. 73, no. 14, Oct. 5, 1918, pp. 526-528, 4 figs. Comparison of various methods of numbering poles; basis of nomenclature; pole numbering specifications of large power company.

Taking Soundings Above Niagara Falls from the Shore, Leon R. Brown. Eng. News-Rec., vol. 81, no. 14, Oct. 3, 1918, pp. 634-637, 5 figs. Experimenting develops effective use of triangular float and weighted pole controlled by cables.

The Utilization of Waste Heat from Open-Hearth Furnaces for the Generation of Steam, Thomas B. Mackenzie. Iron & Steel Inst., advance copy, paper 12, Sept. 12-13, 1918, 24 pp., 4 figs. Report of tests conducted by author with acid-lined open-hearth furnace of 30 tons nominal capacity and Babcock and Wilcox water-tube boiler having 720 sq. ft. heating surface.

Theory and Practice in Gating and Heading Steel Castings, Ralph H. West. Iron & Steel Inst. of Can., vol. 1, no. 8, Sept. 1918, pp. 338-347, 31 figs. Remarks on general çork weighing from 1 to 500 lb., based on author's experience. Before Am. Foundrymen's Assn.

SAND-BLASTING MACHINERY. Automatic Shell Cleaning Cabinet Sand-Blast. Can. Foundryman, vol. 11, 9 Oct. 1918, p. 265, 4 figs. Machine designed to provide continuous operation for cleaning 155-mm. shells with direct high pressure.

On the Distribution of the Energy Stored in Reinforced Concrete Beams and Column-Supported, Flat-Slab Floors, Henry T. Eddy. Jl. Franklin Inst., vol. 186, no. 4, Oct. 1918, pp. 439-448. Analytical interpretation of results obtained in 333 tests carried out by United States Bureau of Standards described in tech. paper 2.

COMPRESSION LOAD. The Coefficient of Safety of Reinforced and Non-reinforced Concrete Bodies Subject to Centrally and Excentrically Applied Compression Loads (Uber den Sicherheitsgrad von Bewehrten and unbetnehrten Betonkörpern, die auf zentrischen und exzentrischen Druck beansprucht werden), C. Bach and D. Graf. Armierter Beton, year 11, no. 5, May 1918, pp. 84-90, 4 figs. (To be continued.)

CORROSION

IRON. The Corrosion of Iron and Steel and its Prevention, [illegible]. [illegible], vol. 9, no. 8, Aug. 1918, pp. 185-186. Important [illegible] of sherardizing; conditions for commercial work.

ELECTROLYTIC PREVENTION. The Cumberland Electrolytic System for the Prevention of Scale and Corrosion. Elecn., vol. 81, no. 2104, Sept. 13, 1918, p. 419, 1 fig. Description of a system used by British navy and merchant marine to prevent scale and corrosion in boilers and condensers.

ACCOUNTING

HIGHWAYS. Classification of Expenditures for Highway Cost Accounting. Good Roads, vol. 16, no. 19, Nov. 9, 1918, pp. 178-180. Outline of system proposed in recent publication of Office of Public Roads and Rural Engineering.

HANDLING MATERIALS. Coke Loading Tipples in the Municipal Gas Works at Düsseldorf (Die Koksverladebrücke des Stadtischen Gaswerkes Düsseldorf). Journal für Gasbeleuchtung, year 61, no. 10, Mar. 9, 1918, p. 117, 1 fig.

WOOD

AEROPLANE WOODS. Defects in Airplane Woods, Samuel J. Record. Sc. Am., vol. 119, no. 11, Sept. 14, 1918, p. 212, 5 figs. Method of judging quality of timber.

HOUSE FINISH. The Uses of Wood (VI), Hu. Maxwell. Am. Forestry, vol. 24, no. 298, Oct. 1918, pp. 593-602, 16 figs. Its employment as house finish.

KILNS. Observation on Kiln Practice, N. S. Potter. Cement & Eng. News, vol. 30, no. 8, Aug. 1918, pp. 35-36. Suggestions as to the points to investigate in connection with raw material, kiln, coal, air, burner, draft and discharged gases, in order to secure efficient operation.

WOOD-WORKING MACHINERY

TIE-DRESSING MACHINE. Machine Dress Railroad Ties Before Treatment. Eng. News-Rec., vol. 81, no. 15, Oct. 10, 1918, 2 figs. Santa Fé stationary and portable plants that saw, adze, bore and brand ties in one continuous operation.

VARIA

Under Engineering Education, Dr. Mann Reports, etc., look up no. of. Elec. World.

ACETYLENE. Dissolved Acetylene and its Applications (Dissousgas og dens Anvendelser). Ingenioren, year 27, no. 80, Oct. 5, 1918, pp. 525-529, 10 figs.

CATALOGUES. After-War Catalogues, Advertisements, etc. Auto, vol. 23, no. 40, Oct. 4, 1918, pp. 727-730. Suggests characteristics of publicity material.

COLOR VISION. A Statistical Survey of Color Vision, R. A. Houstoun. Proc. Roy. Soc., vol. 94, no. A664, Aug. 1, 1918, pp. 576-586, 3 figs. Study of relation of normal vision to color blindness — whether color vision passes gradually into color blindness or the color-blind form a class by themselves.

ENGINEERING EDUCATION. Dr. Mann Reports on His Three Year Study of Engineering Education. Eng. News-Rec., vol. 81, no. 17, Oct. 24, 1918, pp. 742-751. Quotations from report with condensations and comment. Also in Elec. World, vol. 72, pp. 783-788, 6 figs.

War Instruction at Massachusetts "Tech." Elec. World, vol. 72, no. 14, Oct. 5, 1918, pp. 636-638, 6 figs. Instruction and research work have developed rapidly into necessary activities of military, naval and aeronautical character; establishment of unit of Students' Army Training Corps.

HIGH TEMPERATURES. High Temperature Processes and Products, C. B. Darling. Jl. Roy. Soc. of Arts, vol. 66, no. 3431, Aug. 23, 1918, pp. 621-628, 5 figs. Practical uses of temperatures higher than 1700 deg. cent. — oxy-hydrogen flame, oxy-acetylene flame, electric arc, thermit, and electric furnace.

INSURANCE, AUTOMOBILE. Automobile Insurance, a list of references on automobile insurance in the Library of the National Workmen's Compensation Service Bureau, New York, Reference List no. 5, September 1918, 3 pp.

EMPLOYMENT BUREAU

The Government and Technical Men

Editor, *Journal:*

The Dominion Government is at present undertaking a reclassification of its employees in the outside service. In this service there must be several hundreds of technical men who will be directly affected by the results and it is not overstating a fact to say that every member of the profession in the Dominion will be indirectly affected by the status given the technical employees of the Government, by the Civil Service Commission.

What step is *The Institute* taking to safeguard the interests of the profession as a whole, and its members in the service in particular?

I am under the impression that there is not a member of the commission who is a technical man, or one who has the necessary training in, and understanding of technical matters and work to determine the qualifications necessary, or the remuneration to be paid, for the different classes of work embraced in the engineering branches of the different departments. I may be wrong in this impression and I trust I am, but if I am not, *The Institute* should take immediate steps, through its executive, towards having an engineer of prominence (preferably an outside man) placed either on the commission or attached to it, in an advisory capacity.

The Government is the largest single employer of technical men in the Dominion and having recently taken over two transcontinental railways, it becomes the employer of a large proportion of all the technically trained working in Canada.

Suggestions from individuals in the Government employ are discouraged and under the provisions of the recently enacted Civil Service Act, no representations by its employees, in reference to positions or salaries can be made through departmental cbannels—under pain of dismissal. Rightly enough, no internal association of technical men, savoring of trades unionism, would be countenanced by engineers.

It would seem that two important points in the interests of the public, the government, and profession should be effectively impressed on the members of the Government.

1st, a high standard of professional ability should be fixed for the various grades;

2nd, a scale of remuneration high enough to attract and keep men of ability should be established.

These are, of course, simply fundamentals of business principles and practice.

Yours truly,

P. E. DONCASTER, A.M.E.I.C.

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